# Current Science, Vol. XXIII, 1954

## Author Index

# Subject Index

## ENCOURAGEMENT OF SCIENTISTS*

IT appears that there is a wide disparity between the emoluments of scientists in the Universities and those in administrative positions, mostly in Government or semi-Government Departments. Our first demand must, therefore, be for a uniform Scientific Service, with defined grades of status and pay, which have enough flexibility to permit unusual promotions by merit, and in which the salary differences between grades recognise service and ability without causing resentment and difficulty in the junior grades.

Although a comprehensive and integrated Scientific Service would, by virtue of the social understanding which produced it, recognise the directions in which scientists should be encouraged to improve their quality and extend their usefulness, nevertheless recognition will not be transformed into consistent action unless scientists themselves participate fully, and in an organised manner, in the transformation. It may be useful at this stage to consider the main directions in which scientists deserve encouragements that will benefit science and public welfare generally.

* Excerpts from the Presidential Address of Dr. S. L. Hora to the Indian Science Congress, 1954.

One obvious group of these directions would come under the heading of "Facilities". We need well-built, well-equipped, gracious places of· work, which is no more than all workers need, except that some of our places of work should be very specifically planned for the work that is to be done in them. We need more libraries and the expansion of existing libraries, together with convenient access to general libraries that will help us to keep abreast with the advance of knowledge outside our fields. We also need, I believe, to build up personal libraries and to subscribe, in larger numbers than we do now, to periodicals important to our work and thought—which, in turn, means joining more societies than we do now.

This last point is extremely important, and you will have noted that its importance was stressed by Sir Asutosh Mookerjee at our first meeting. Indeed, intellectual stimuli through reading and personal contacts are so important that there is no doubt that, when our economic position improves, we shall relax more in the good company of books and fellow-workers at home and abroad, within our own fields and far outside them.

But for juniors, difficulties will remain even under improved economic conditions. I

accordingly suggest that funds should be established for making "book grants", that all our learned societies should allow "student members" or "associate members" at greatly reduced rates, and that these societies, helped by far-seeing philanthropists, and together with the Central and State Governments, should sponsor tours by juniors and students to various parts of India and abroad, sometimes to conferences but often for study and experience alone.

So much for facilities. There remains the associated question of "Rewards". The career of a junior in science (and, of course, in any branch of learning) must be secured as soon as he shows aptitude and positive intentions. He must be able to see in the Scientific Service, or in other opportunities for scientific employment, the fulfilment of his efforts and dreams.

But this is not enough. Before he begins his regular work he must be able to pursue and conclude some research of his own design at some centre of his own choosing, for a period which may vary from 1-3 years, according to his own purpose and performance. We know the usual way of providing such encouragements is to grant scholarships and fellowships through various agencies, and there is scarcely any need for me to say that they should be greatly increased in scope and quantity.

I come now to workers at the other end of their careers. All my correspondents are agreed that an incalculable wastage of scientific experience is going on in India through the neglect of retired scientists; and that this wastage not only applies to the work they themselves could be producing, but also to wastage in the efforts and directions of the young men and women who were working under their guidance.

Of these, some, no doubt, can still afford to continue their enquiries without payment; but they are not necessarily allowed to do so. There are gravely disturbing cases of gifted scientists, with records that would have brought them the highest honours elsewhere being refused "sitting accommodation" in the institutions they served for more than three decades. Their number is, however, far exceeded by the men who wish to continue their work; but cannot do so for financial reasons. They have to find other employment, sometimes in executive positions, sometimes in subordinate ones. In this connection, it is necessary to remember, as Dr. J. N. Ray has pointed out to me that "the expectation of life in India has now been increased by at least ten years".

There remains the question of rewards for those who are neither at the beginning nor near the end of their careers. Their rewards would lie largely in the satisfactions of work and social duty, and in the recognition which comes to them. Apart from Departmental and official recognition, and tokens of appreciation from international sources, there are the recognitions expressed by one's colleagues through selection to the honours of learned societies. I do want to say, however, that, to the best of my knowledge, no society anywhere has solved the question of "fairness" to the satisfaction of all its members, since "fairness" is apt to be individually defined. At the same time, the position continuously improves in every reputable society everywhere, in response to progress in the sense of responsibility of its Fellows, in whom a high regard for a flexible and democratic election procedure, with provision for complaints and appeals, thereby becomes increasingly evident.

## RESPONSIVENESS OF NERVE CELLS

THE means by which the human brain is modified by its own past activity were discussed by Dr. E. D. Adrian, O.M., President of the Royal Society, in his address at the anniversary meeting of the Society held at Burlington House recently.

There were already some indications, Dr. Adrian stated, of the kind of alteration which may be produced in a nerve cell by repeated activity. Repeated stimulation of the nerve cells of the brain produced an increased responsiveness which could last for a minute or so, and Professor J. C. Eccles of the Australian National University, Canberra, and his colleagues had shown lately that even in the spinal cord, whose function was purely executive, a long period of inactivity led to a loss

of responsiveness which was restored by a short period of enforced activity and tended to persist for a matter of hours.

For the study of physical changes which accompany these alterations there was available an extension of a method, again introduced by Professor Eccles, by which the interior of a nerve cell could be examined by the use of a micro-electrode. It was naturally more difficult to study the biochemistry of the individual nerve cell, but the storage process might well involve a chemical as well as a physical reorganisation. If the cell chemistry of a grown man could bear the mark of an infection with measles in childhood, it was not unreasonable to suppose that the nerve cell constituents were plastic enough to be modified by past activity

# RICE DIETS AND FERTILITY RATE

## S. RANGANATHAN

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THE concentration of a major portion of the world's population in the rice belts of the world has given rise to speculations about a possible correlation between consumption of rice diets and increased human fertility rate. While this association was never scientifically and critically examined, it was allowed to gain ground in lay circles. An additional impetus was given to it by utterances emanating from Japanese sources and reported in the lay Press in India about a year ago; since then, the existence of this association was taken for granted and repeated often. Mention was made in the Press recently about the Government of India seriously thinking of starting investigations to find out the existence or otherwise of an association between rice consumption and fertility. It is but meet that the existing data on the subject, collected at great pains and expense by Governmental agencies, should be pooled and critically assessed, before fresh investigations are undertaken. If the results of such an enquiry should prove inconclusive, the need for fresh investigation would obviously arise. An attempt has, therefore, been made to assess the existing data in India and elsewhere from this particular angle.

Fortunately, figures of birth-rate are available, 'State-wise' ('Province-wise' before the partition of India in 1947), published annually by the Director-General of Health Services, Government of India. It is also fortunate that the Provinces of India, now called the States, fall into certain fairly well-defined divisions so far as the staple article of the diet of the population is concerned. Thus, it is possible to differentiate broadly the rice-eating States from those where the staple article of food is something other than rice, say wheat or millets. Assam, Bengal (after 1947, West Bengal) and Madras are the three principal rice-eating areas of India, while the Punjab, United Provinces and Ajmere-Merwara are predominantly wheat-eating areas. The birth-rates per mille for 12 States of India for the four years, 1946 to 1949—figures for 1949 are the latest available—and the average birth-rate for the entire Indian Union for the same period are given in Table I (*Statistical Appendices to Annual Report of the Director-General of Health Services*[2] for the years 1948 and 1949, Part I).

It will be seen from Table I that the lowest birth-rates in India are to be found in Coorg

### TABLE I

*Birth-rate per mille*

|  |  | 1946 | 1947 | 1948 | 1949 |
|---|---|---|---|---|---|
| Ajmere-Merwara | .. | 33·4 | 33·9 | 25·7 | 26·6 |
| Assam | .. | 18·9 | 15·6 | 15·3 | 15·1 |
| Bihar | .. | 23·0 | 18·6 | 18·0 | 17·7 |
| Bombay | .. | 33·8 | 33·6 | 32·5 | 33·5 |
| Coorg | .. | 18·8 | 17·8 | 15·1 | 17·6 |
| Delhi | .. | 35·5 | 29·8 | 25·6 | 31·2 |
| Madhya Pradesh | .. | 37·2 | 34·9 | 33·2 | 35·5 |
| Madras | .. | 32·1 | 33·2 | 30·8 | 30·9 |
| Orissa | .. | 28·5 | 27·8 | 27·2 | 26·6 |
| Punjab (I) | .. | 38·3 | 32·8 | 35·0 | 38·4 |
| Uttar Pradesh | .. | 25·3 | 23·3 | 20·6 | 22·3 |
| West Bengal | .. | 23·8 | 19·2 | 20·4 | 21·1 |
| Indian Union | .. | 29·2 | 26·6 | 25·2 | 26·4 |

and Assam, both of them being principally rice-eating areas. The figures range from about 15-18 per mille and are well below the average of about 25-29 for the Indian Union. This consistently low figure should give the quietus to the theory that rice diets conduce to increased fertility. Additional data showing lack of correlation between rice consumption and fertility are again available from the same table. The birth-rate for the Punjab, an almost exclusively wheat-eating area, is the highest in India and amounts to 38·4 per mille (1949); rice enters but little into the diet in the Punjab. Again, the birth-rates in the States of Bombay, Madhya Pradesh and Delhi are equally high, all being well over 30 per mille; the staple articles of diet in these regions are millets and wheat. The birth-rate in the Madras State, a predominantly rice-eating area, is no doubt high, being in the neighbourhood of 30 but the fact that it is nearabouts the same or lower than the figures obtaining in areas where rice hardly enters into the diet of the people should provide unequivocal evidence of the lack of any association between rice diets and fertility rate.

Quite apart from the data published by the Director-General, Health Services, Government of India, an examination of the figures given by other demographers point to the same conclusion. Table II gives data of birth-rates for ten Provinces together with figures for all-India for the three decennial periods ending with 1931

(Gyan Chand[3]). The same figures have also been quoted by Blunt[1] and by Radhakamal Mukerjee.[4] Unfortunately, the sources from which these figures have been obtained are not mentioned. However, they should prove useful in so far as a comparison could be instituted within the table itself.

TABLE II

*Birth-rate per mille*

|  | | 1901–11 | 1911–21 | 1921–31 |
|---|---|---|---|---|
| Assam | .. | 35·7 | 32·3 | 30·3 |
| Bengal | .. | 37·6 | 32·8 | 28·5 |
| Bihar and Orissa | .. | 41·0 | 38·8 | 36·3 |
| Bombay | .. | 33·4 | 34·2 | 35·9 |
| Madhya Pradesh | .. | 49·6 | 45·5 | 43·7 |
| Madras | .. | 30·8 | 30·7 | 34·6 |
| Mysore | .. | 17·1 | 19·0 | 18·9 |
| N.-W. Frontier Province | | 34·6 | 32·8 | 28·0 |
| Uttar Pradesh | .. | 41·4 | 42·2 | 35·1 |
| Punjab | .. | 41·2 | 43·8 | 42·2 |
| All-India | .. | 38·0 | 37·0 | 35·0 |

The figures in the above table afford incontrovertible evidence for the same lack of association between rice consumption and birthrate. Madhya Pradesh, Punjab and Uttar Pradesh have a higher birth-rate than the Provinces of Madras and Bengal, principal rice-eating areas of India.

Again, figures for population increase during the last three decades shown in Table III reveal the same story (B. Viswanath[5]).

TABLE III

*Showing percentage of population increase*

|  | | 1921–31 | 1931–41 | 1941–51 |
|---|---|---|---|---|
| Indian Union | .. | 14·3 | 13·4 | 13·4 |
| Travancore-Cochin | .. | 26·3 | 18·9 | 23·6 |
| Madras | .. | 10·0 | 11·6 | 14·3 |
| Uttar Pradesh | .. | 6·7 | 13·6 | 11·9 |
| Bihar | .. | 11·6 | 12·3 | 12·3 |
| Madhya Pradesh | .. | 13·7 | 10·3 | 8·6 |
| Punjab | .. | 9·9 | 17·9 | ? |

Travancore-Cochin State shows the highest increase. This State is highly deficit in rice, and produces and consumes tapioca and sweet potato in large quantities. This fact, again, does not appear to square with the idea of rice diet promoting fertility. The population increases in Uttar Pradesh, Bihar and Madras are

very nearly alike and yet, only in the State of Madras, rice forms the principal article of diet of the majority of the population, though in certain parts of Bihar and Eastern U.P., rice may form the staple. Further, there was a greater incease in population in Madras during 1941-51, when some wheat replaced rice on account of the shortage of the latter, than in the corresponding periods of 1931-41 and 1921-31 when practically nothing but rice constituted the staple food for the bulk of the population.

Having studied the figures available for the various States in India, a comparison may now be instituted between the birth-rates in the rice-consuming countries of the world and the corresponding figures for the non-rice-eating areas. Comparative data for ten countries are given in Table IV (Gyan Chand,[3] *loc. cit.*).

TABLE IV

*Birth-rate per mille*

|  | | 1881–91 | 1921–25 | 1926–30 | 1931–35 |
|---|---|---|---|---|---|
| United Kingdom | .. | 32·5 | 20·4 | 17·2 | 15·5 |
| Sweden | .. | 39·1 | 19·1 | 15·9 | 14·1 |
| Norway | .. | 31·0 | 22·2 | 18·0 | 15·3 |
| Germany | .. | 36·8 | 22·1 | 18·4 | 15·9 |
| France | .. | 23·9 | 19·3 | 18·2 | 16·5 |
| Spain | .. | 36·2 | 29·8 | 28·5 | 26·9 |
| Japan | .. | 27·2 | 34·6 | 33·5 | 31·6 |
| Rumania | .. | 41·4 | 37·9 | 35·2 | 32·8 |
| India | .. | 35·9 | 32·7 | 33·3 | 34·3 |
| Italy | .. | 37·7 | 29·7 | 26·8 | 23·8 |

The figures in the above table do not show any specific correlation between rice consumption and fertility. On the other hand, they show a general fall in the birth-rate in the Western countries during the last about 40 years, with no major change taking place in dietary habits in so far as the staple article is concerned; presumably due to social conditions and artificial measures adopted to restrict births. The birth-rate in India has remained more or less steady during this period while in Japan, there has been an increase from 1881-91 levels. The chief cause for this rise is to be sought elsewhere than in the diet. The severe laws passed against abortion and infanticide, motivated probably by political considerations, has helped to raise the birth-rate from about 25 in 1872 to 34·6 in 1921-25, a rise unique in the history of population growth. Japan has been subsisting on rice for æons of time. Yet, her birth-rate was only 27·2 during 1881-91,

being the lowest among the ten countries for which figures have been given in Table IV, the only exception being France.  Again, figures for the trend of birth-rates compiled by Whelpton and Kiser[6] for the various countries of the world show that Central and South America have a higher birth-rate than India and Japan.

Thus, it should be clear that the existing data in India and elsewhere do not reveal any association between consumption of rice diets and increased human fertility.

1. Blunt, Sir Edward, *Social Service in India*, 1938, His Majesty's Stationery Office, London.

2. Director-General of Health Services, *Statistical Appendices to Annual Report for the years* 1948 *and* 1949, 1953, Manager of Publications, Delhi.

3. Gyan Chand, *India's Teeming Millions*, 1939, George Allen & Unwin Ltd., London.

4. Mukherjee, Radhakamal, *Food Planning for Four Hundred Millions*, 1938, McMillan & Co., London.

5. Viswanath, B., *Symposium, Central Food Technological Research Institute, Mysore,* 1952.

6. Whelpton, P. K. and Kiser, C. V., *Annals of the American Academy of Political and Social Science,* 1945, **237**, 112.

## Dr. HEM SINGH PRUTHI

ON the 30th November 1953, Dr. Hem Singh Pruthi, Plant Protection Adviser to the Government of India, and Director, Locust Control, proceeded on leave preparatory to retirement. The event marks not only a change in his personal career but also a stage in the development of entomological research and plant protection in this country.

Dr. Pruthi's early researches dealt with the morphology of some Rhynchota and Coleoptera and while at Cambridge he also studied the influence of chemical and physical conditions of water on aquatic animals, a line of research which he continued in the Zoological Survey of India at Calcutta.  At the Indian Agricultural Research Institute, the study of crop and other pests and the methods of their control naturally engaged his major attention.  Part of his researches also concerned the insect vectors of virus diseases of plants, a subject, which had received hardly any attention in India before. He worked and guided others so as to produce valuable contributions to the biology, ecology, systematics and control of pests of cotton, sugarcane, fruit trees, etc.  Two of his notable monographs have been on the desert locust and pests of stored grains.  While his distinguished predecessor, Mr. T. Bainbridge Fletcher, was a great Systematist, Dr. Pruthi may be regarded as a pioneer in many fields of research designed to provide basic information for solving the problems of pest control in different parts of India.  In 1943, the University of Cambridge conferred on him its Sc.D. Degree for his researches carried out in India.

Dr. Pruthi was largely responsible for the establishment of the Locust Warning Organization established by the Government of India in 1939 and he was put in charge of it and remained so up till the time of his retirement.

During the last 25 years, Dr. Pruthi has been exercising an influence over entomological research and plant protection over a country of the size of the undivided India, to an extent to which it has not been given to many entomologists to do.  Under his leadership entomological research in India began to be coordinated and the sciences of entomology, plant pathology and even of chemistry drew closer to solve practical problems.  Entomologists all over India looked to him for inspiration and guidance and the subject of plant protection acquired new importance.  His has indeed been a crowded life of persistent endeavours, effective planning and solid achievements.  Few entomologists have had closer associations with Dr. Pruthi in his scientific work and endeavours than the present writer.  The impression about Dr. Pruthi that survives with him, as it must be with many others, is of a forceful personality in which the scientist, the administrator, the organizer and the man of sympathy and understanding are happily blended.  It is fortunate, therefore, that Dr. Pruthi's retirement from Government service does not mean his retirement from active scientific life and work and all of us must wish him many more years of good health in the cause of scientific research and crop protection.

K. B. LAL.

# CENTRAL LABORATORIES FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, HYDERABAD (DN.)

THE Central Laboratories for Scientific and Industrial Research, Hyderabad (Dn.), which was recently declared open by Shri Pandit Jawaharlal Nehru, Prime Minister of India, aims at furthering the work of the National Laboratories on a regional level and has the following functions: to help and encourage the development of Hyderabad State by organized scientific and industrial research through (a) exploration of the possibilities of industrial utilization of the indigenous raw materials of Hyderabad State; (b) devising methods for the expansion of existing industries, and formulating plans for the starting of new industries, by carrying out experimental work on a pilot plant scale in the laboratories.

The main purpose of the Laboratories is to carry out developmental research of an industrial nature covering the fundamental as well as applied aspects of each problem. Research problems taken up for investigation are initially put forward by Research Committees, Government Departments of Industries, or are brought up during discussion between the Director and research workers. The problem is discussed in detail in the Operational Resarch Unit and a decision taken regarding its importance and feasibility. Subsequently, information relating to the availability of raw materials, demand for finished products, their market prices, etc., is collected and a Literature Note is prepared incorporating all the data available. This note is discussed anew by the Operational Research Unit and a detailed programme of work with a time target is drawn up. On successful completion of the laboratory investigation, the Pilot Plant Committee studies the chemical engineering aspects of the problem in its translation to the pilot plant stage, and prepares a non-technical note with approximate costings, for circulation among interested industries. Pilot plant experiments are then undertaken either in the Laboratories or by industries, and an industrial process is evolved on the basis of these trials. The Pilot Plant Schemes are also sent to the various specialized bodies of the Government of India, like the Indian Central Oilseeds Committee, the Council of Scientific and Industrial Research, the National Research Development Corporation and others.

In the selection of the research programme, every effort is made at all stages, to co-ordinate the work with that of the National Laboratories, and care is taken to avoid unnecessary duplication of effort.

# VIBROFLOTATION

SAND, which is normally a poor foundation for large heavy buildings, can now be made to serve as a satisfactory base by a new process called "vibroflotation", which increases the relative density of the soil by compacting and compressing into a dense mass. The device consists of a tube which is vibrated by an internal electrically driven eccentric producing a 10-ton centrifugal force. This apparatus is attached to a follow-up pipe which houses the water mains and electric lines. In operation, the Vibroflot is suspended from a crane and guided by vertical wooden leads. Vibrating at full speed, it is lowered into the sand while a water jet at its tip forms a saturated mass of sand or temporary "quick-sand" condition, into which the vibrator rapidly sinks. The device pounds the sand surrounding it into a lighter mass on all sides. Fresh sand is shovelled in from above to fill the extra space which is formed by compaction. The vibrator is withdrawn in 1-foot stages. Tightly compacted columns of sand, 8-10' in diameter, are formed, which are pounded in a pre-determined overlapping pattern with about 8' between centres. The pattern, resulting in a relative density of 70-100 per cent., greatly strengthens the compacted mass.

The technique has a promising future in the construction of earth dams, coffer-dams, levees, airports in sandy areas, and heavy industrial plants which contain vibrating equipment. Another special use is in water-retaining dams and underwater structures where vibroflotation concrete can create unusually tight structures. (By courtesy of USIS Engng Newsletter.)

# LETTERS TO THE EDITOR

## LATE PRE-CAMBRIAN GLACIATION IN CENTRAL INDIA—A REJOINDER*

V. S. DUBEY AND M. S. CHAUDHARY in their paper entitled "Late Pre-Cambrian Glaciation in Central India" (Current Science, December, 1952, Vol. 21, pp. 331-32) have, in their anxiety to prove glaciation in this period, stretched the available evidence too far. I have devoted considerable time in field work in the Son Valley and the Bijawar type area, and my own observations do not support the conclusions arrived at by the above authors. As far as I can see, the basal conglomerate of the Semri Series

(Lower Vindhyan) is undoubtedly not a til-lite. The evidence given by Auden[1] about its non-glacial origin is complete and these authors have not brought out any fact which would lead one to suppose that it is otherwise. The presence of fresh feldspars in the matrix is not in itself a conclusive evidence of its glacial origin. It is also contradicted by the above authors' own remarks that the Basal Semri bed is a fine-grained silicious rock and that the conglomerate merges into a coarse-grained quartzite at the top. The rock described by Oldham, et al.[2] referred to by Dubey and Chaudhary appears to be a tillite, but it occu-

pies a horizon other than the Basal Semri (and may possibly be equivalent to the Bijawars). Hence their grouping the two together in one and the same horizon is erroneous. It may also be noted here that the maximum distance between the Banas and the Gopath rivers is about 60 miles and not 100 miles as stated by the aforementioned two authors.

That the formation below the Semris in the Ken Valley is a tillite appears to be reasonably certain. The above two authors say that this tillite occupies a position "just below the Semri Series and overlying the Bijawars". They do not categorically state to what system this Ken Valley tillite should be assigned, but it is obviously implied that they would group it along with the Semris. From a careful examination of the area, however, it is abundantly clear that there is a distinct unconformity between the tillite and the overlying sandstone, and there can be no question of putting the two together in the same system. I consider that the tillite should be grouped with the underlying beds and assigned to the Bijawars, and that it was formed when the Bijawar period was coming to a close.

It would thus be seen that whereas in the Son Valley the conglomerate bed, being conformable with the overlying sediments, is a part and parcel of the Semri Series, that in the Ken Valley is conformable with the Bijawars; and the two conglomerates are not of a common horizon. Lithologically also it is to be noted that the two are very different from each other, as has also been noted by the authors themselves. Furthermore, the Son Valley Basal Semri conglomerate was formed by the action of water; while the Ken Valley rock is of glacial origin.

It occurs to me that Dubey and Chaudhary's contention that the Ken Valley glaciation took place in the "late Pre-Cambrian" times is also rather premature. The age and stratigraphical position of the Bijawars are uncertain even now; and unless they are fixed with a reasonable degree of accuracy, it would be unwise to make any categorical statement.

I have had the inestimable advantage of discussing this subject with Dr. A. G. Jhingran, Superintending Geologist, Geological Survey of India, to whom I offer my most sincere thanks.

Geological Survey of India,     S. M. MATHUR.
Lucknow, *November 6, 1953.*

* Published by permission of the Director, Geological Survey of India.
1. Auden, J. B., *Mem. Geol. Surv. India*, 1933, **62**, 2.
2. Oldham, R. D., Datta, P. N. and Vredenburg, E., *Ibid.*, 1901, **31**, 1.

# UNIT CELL AND SPACE GROUP OF MORELLIN

MORELLIN, an antibiotic from *Garcinia morella*,[1] can be obtained by repeated crystallisation in the form of orange coloured needles and having a melting point of approximately 157° C. To Mr. S. C. L. Verma, the author's thanks are due for the loan of these crystals as well as for the density determinations. No previous optical or structural studies have been made of these crystals.

Goniometric studies using a Unicam two-circle optical goniometer indicated a symmetry 4 or $4/m$ for these crystals, the needle axis being the four-fold axis. The prism zones commonly observed are $\{100\}$ and $\{210\}$ with this symmetry. Laue oscillation and Weissenberg photographs with X-ray beam both perpendicular and parallel to the needle axis confirmed the point group as $4/m$. The measurements of these photographs gave the following values for the unit cell dimensions

$$a = b = 15 \cdot 89 \pm \cdot 04 \; ; \quad c = 11 \cdot 60 \pm \cdot 02 \text{ Å}.$$

These values, along with the density $1 \cdot 234$ for these crystals, give the molecular weight of morellin to be $2176/Z$ where $Z$ is the number of molecules per unit cell. Taking $Z$ to be 4, we get the value 544 for the molecular weight. The value measured by chemical methods was 483 whereas the suggested formulæ $C_{30}H_{34}O_6$ and $C_{29}H_{32}O_5$ give the molecular weight 490 and 476 respectively.[1] The X-ray molecular weight 544 (which has an accuracy better than $\pm 10$) is thus definitely higher. This discrepancy must be cleared up and is being looked into by Dr. P. L. N. Rao and Mr. S. C. L. Verma (personal communication).

Detailed indexing of all the reflections in the $hk0$, $hkl$ and $0kl$ Weissenberg photographs indicated no systematic general absences showing that the lattice is primitive. However, the only observed $00l$ reflections were the 004 and 008. This suggests that the space group is $C_{4h}^2 = P4_2/m$. Since there are eight general equivalent positions for this space group, the molecule must possess either a reflection plane or a two-fold rotational axis. As the molecule is found to be optically active it is probable that it is the rotational symmetry that is present.

The author's thanks are due to Dr. G. N. Ramachandran for his guidance.

Dept. of Physics,     GOPINATH KARTHA.
University of Madras,
Madras-25, *December 8, 1953.*

1. Rao, P. L. N. and Verma, S. C. L., *J. Sci. Ind. Res.*, 1952, **11B**, 206.

## *SIDEROLITES* FROM THE CRETA-CEOUS ROCKS NEAR ARIYALUR (S. INDIA)

In the paper on the 'Orbitoids from the Cretaceous Rocks near Ariyalur' recently published by the author in *Current Science* (Sep., 1953), the occurrence of abundant remains of *Siderolites* in these rocks along with the Orbitoids, was reported. These have now been examined in a general way, and the main observations are briefly recorded in the present note.

fauna occurs abundantly in the basal part of the 'Dunghan' limestone in Quetta, and the hilly regions in North-Western Baluchistan.

Some of the common forms of *Siderolites* noticed in the Ariyalur material now under study are shown in the following microphotographs (Figs. 1-6); and it may be mentioned that these few photographs hardly do justice to the abundance and variety of these fossil forms noticed in the entire collection. The six examples figured now are more or less meridian sections and give a good idea of the shape,

FIG. 1 × 22                    FIG. 2 × 16                    FIG. 3 × 28



FIG. 4 × 24                    FIG. 5 × 26                    FIG. 6 × 26

The 'rare' presence of *Siderolites* in the Ariyalur rocks was first mentioned by S. R. N. Rao about 12 years ago[1]; R. S. Sharma has more recently found this fossil in the Upper Cretaceous beds of the Pondicherry area.[2] In both cases, just a mention has been made of the occurrence and no descriptions have been given. It is also understood from the geologists of the Pakistan Petroleum Ltd., that *Siderolites* associated with typical Mæstrichtian-

size and mode of arrangement of the chambers, as also of the spines which form such a characteristic and striking feature.

It must, however, be pointed out that in almost all these cases the fossil is incomplete, chiefly in the sense that the outermost whorl of chambers, surrounding the 'body', and often also the 'spines', is missing; its presence in the entire form, however, is clearly indicated in cases where the fossil, relatively speaking, is

3

better preserved. One important point which comes out very clearly in all these cases is that the 'spines' are not mere outgrowths from the peripheral portions of the 'supplemental skeleton' but are more deep-rooted, arising almost right from the centre. The prominent 'pillars' which also proceed from the centre, and appear as knobs on the two sides of the test are very well seen in some of the sections. In addition to these spines and pillars, the outer walls of the chambers possess a finely granular ornamentation presenting, in sections, a nice 'pectinate' appearance, and the walls of the chambers themselves frequently show a transversely fibrous structure. All these features which can be seen in one or the other of the above photographs make this foraminifer a most striking and impressive form.

In the meridian sections which pass right through the centre, we get a good idea of the nature and disposition of the earlier chambers, and a detailed examination of this region (in both meridian and equatorial sections) is of the greatest importance; in fact, the sharp difference of opinion regarding the systematic position itself of *Siderolites*—whether it belongs to the Camerinidæ or the Calcarinidæ—arises from differences in the views held regarding the arrangement of these early chambers, as to whether they are planispiral or rotaline. Luckily we have in our material quite a number of sections showing these central chambers, and a careful study of these to determine if all of them are uniformly of one kind or the other will obviously be of great value in the elucidation of this problem. The recent proposal of Hanzawa[3] arising from his studies of certain Cretaceous and Tertiary Foraminifera from the West Indies to erect a new family—Pellatispiridæ, intermediate in position between the Camerinidæ and the Calcarinidæ, makes the position even more interesting. A comparison of some of our sections with those of *Pellatispirella* figured by him show some striking similarities. It looks as though we have now to consider the whole question of the affinities of *Siderolites* vis-a-vis the Camerinidæ, Calcarinidæ and Pellatispiridæ. In this connection the study of the nature of the canal system in these groups becomes necessary.

Another important aspect of the study of *Siderolites* is in relation to the foraminiferal genus *Miscellanea* proposed by Pfender[4] and to which she transferred quite a number of fossils from the Paleocene and Lower Tertiary beds previously described by Douville, Nuttall, Davies and others as *Siderolites miscella*. In this vauable paper, Pfender has pointed out

the reasons for such a change, and has also published nice figures of true *Siderolites* and her new *Miscellanea,* together with those of *Rotalia* cf. *trochidiformis* referred to in her discussion. Whether Pfender's work implies that there is no true *Siderolites* at all in the Lower Tertiary beds is a point for consideration ; such a suggestion would probably be not correct.*

From what has been said above it is evident that the study of *Siderolites* and its associated many-sided problems is of great interest. We know very little of this fossil from India, and no detailed descriptions and figures are available. In the material now under study, there is a rich collection of a variety of these forms, and we get all possible sectional views ranging from the truly meridian to those which are nicely equatorial; and since these fossils are so abundant in some specimens of the sandstone, it should also be possible to disintegrate the rock and separate the shells for examination. It is thus obvious that here we have excellent scope for comprehensive studies which may be expected to throw valuable light on the many interesting aspects of this important fossil.

This work is under progress, and a full paper will be published shortly.

Bangalore,                  L. RAMA RAO.
*December* 11, 1953.

\* In one of the rocks from the Pondicherry area which I am now examining, several fine sections of *Siderolites* have also been noticed. These seem to be different from the forms now being described from Ariyalur. It is now well known that in the Pondicherry area we have some lower Eocene beds also in addition to the Cretaceous series. The question of the exact age of this *Siderolites*-bearing rock from Pondicherry is under investigation (1-1-1954).

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## WALL-ROCKS FROM MANGANESE QUARRIES OF VISAKHAPATNAM AND SRIKAKULAM DISTRICTS

MINERALOGICAL constitution and textural features of wall-rocks from manganese quarries collected by the author from Gotnandi (Long. 83° 36'; and Lat. 18° 31'), Garraju Chipurupalle in Srikakulam District, and of Gotivada (Long. 82° 44'; and Lat. 17° 33') collected by Prof. C. Mahadevan in Visakhapatnam District, are of particular interest in that they are similar to

the manganese-bearing rocks of Madhya Pradesh (C.P.).

The Gotnandi specimen is a fine-grained, dark manganiferous quartzite, consisting of quartz and manganese ore. The quartz grains vary in shape and size, the interstitial space being occupied by manganese ore. Under the microscope, it has brecciated appearance indicative of crushing and recrystallization (Microphoto). The wall-rock from Gotivada manganese quarry is equigranular and fine-grained,



*Qz.*—Quartz. Black—Mn. ore

and consists of quartz and manganese-garnet in equal proportions. Coarse-grained rock types of this nature occur in the abandoned manganese quarries of Garraju Chipurupalle, 1½ miles east of Gotnandi, while in the quarry which is now being worked, pink and red garnets occur abundantly, which show progressive alteration to manganese ore. The texture is typically gneissic. The manganese quartz rocks of Gotnandi and the quartz manganese garnet-gneisses of Gotivada and Garraju Chipurupalle may represent the varying nature of original manganese deposition. The arenaceous sediments with associated manganese might have given rise to quartzites rich in manganese, and the impure argillaceous manganiferous sediments are presumed to have formed garnet-gneisses on metamorphism. These rocks are similar to the 'Gondites' of Madhya Pradesh in that both are primarily manganese-bearing sediments, later metamorphosed. The absence of apatite and potash felspar from both the ore body and the wall-rock in these localities appears to go against the suggestion of Fermor[1] that the intrusive 'Kodurites' are responsible for the manganese deposits of Visakhapatnam. A detailed paper on the wall-rock alteration of these deposits will be published elsewhere.

I am thankful to Prof. C. Mahadevan for his interest in the work.

Dept. of Geology,    J. S. R. KRISHNA RAO.
Waltair, *November* 23, 1953.

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## MICROFOSSILS FROM THE DOGRA SLATES (PRE-CAMBRIAN) OF KASHMIR

THE name Dogra slates was applied by D. N. Wadia[1] to a prominent belt of slates, which form the south-west flank of Pir Panjal and Dhauladhar ranges of the Kashmir Himalaya. These show a transitional passage into the overlying fossiliferous Cambrian beds and have been hitherto regarded as unfossiliferous. Their stratigraphical position and probable equivalents, according to him, are as follows (see Table I below).

Specimens of the Dogra slates collected from Baramula (34-35° : 74-75°) by one of the present authors have been examined for microfossils. Thin sections when examined under the microscope revealed obscure organic remains, which, on further examination under the phase-contrast microscope showed sufficient details for identifying some of them as radiolaria and some as doubtful algal remains.

TABLE I

| Kashmir | Hazara | Spiti-Simla | Ages |
|---|---|---|---|
| Cambrian of Hundawar and Lidar with *Lingulella, Agnostus* and *Ptychoparia* 5,000 ft. | | Haimanta system | Cambrian |
| Lower Cambrian of Shamsh Abari 3,000 ft. | Hazara and Attock slates | Simla slates | ? Lr. Cambrian |
| Dogra slates (passing conformably into Lower Cambrian) 5,000 ft. | | | Torridonian |
| | Nonconformity Salkhala series | | |
| Salkhala series (Many thousands of feet thick) | | Jutogh and Chail series, Vaikrita series | Algonkian |

The rock examined is fine-grained, argillaceous, with generally oblique cleavage, phyllitic, with occasional gritty layers, and blue-



Fig. 1 represents the common type of radiolaria found in this rock. The skeleton is spherical, honey-comb like, smooth, single lattice-sphere with sub-angular to hexagonal unequal pores, 9 to 13 pores across diameter of sphere, polar spines not preserved, diameter of sphere ranging from 32-85 $\mu$ in various sections. The medullary sphere is not distinct. The pores are sometimes filled up by a dark almost opaque substance, having diameter of 6-7 $\mu$ in the bigger specimens. Radiolarians have been reported from rocks ranging in ages from the Pre-Cambrian to Recent. They are common in Pre-Cambrian quartzites interbedded with gneiss in North-Western France.[2]

Figs. 2 & 3: These appear to be fragments of the thallus of a *Dasycladacea*. Sporangia are represented by black rounded bodies of 12-20 $\mu$ in diameter arranged in linear series.

Figs. 4 & 5: These are also algal remains. The sporangia, which are elongated, vary in thickness from 29-40 $\mu$.

Fig. 6: This is an indeterminate fossil with fine wavy parallel striations.

The present study indicates that the Dogra slates are fossiliferous and it is hoped that further investigations in progress may yield micro-palæontological data of sufficient importance in fixing the age of the beds.

We are grateful to Dr. B. Mukherji, Director, Central Drug Research Institute, Lucknow, for providing us facilities for the use of phase-contrast microscope.

Dept. of Geology,     S. R. N. Rao.
University of Lucknow,     Krishna Mohan.
Lucknow,    *October* 20, 1953.

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FIG. 1. Camera lucida drawing of a Radiolarian test under the phase-contrast microscope, × 640.
FIG. 2. Dasycladacea, × 50.
FIG. 3. Dasycladacea. Portion of Fig. 2 further magnified to show the sporangia, × 170.
FIG. 4. Dasycladacea, × 45.
FIG. 5. Dasycladacea. Portion of Fig. 4 further magnified to show the sporangia, × 170.
FIG. 6. An indeterminate fossil, × 45.
(Photos 2-6 are under the phase–contrast microscope.)

rey to dark in colour. There are no signs of marked metamorphism. The rock is devoid of mega-fossils.

## CONDENSATION OF REYCHLER'S ACID WITH *O*-PHENYLENEDIAMINE

THE crystallisation of the condensation product of o-phenylenediamine with d-camphor-10-sulphonic acid when taken in molar proportions presented some difficulties. Initially, a white crystalline compound separated and this gradually changed its colour to deep orange when repeatedly crystallised out of a mixture of ethyl acetate and ethyl alcohol. Presumably this deep orange compound is of the Ketimine form (II) whose formation has been proposed[1,2,3] to explain the mutarotation of the primary amine salts (I) of Reychler's acid.

CH₂·SO₃H·H₂NR  ~~structure I~~  CH₂·SO₃H  ~~structure II~~

(I)                    (II)
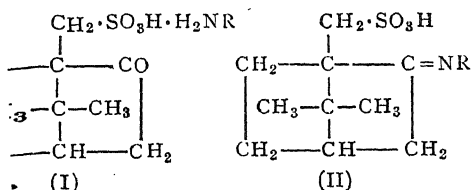
.s orange yellow compound melts at 168-
and is very soluble in water, ethyl alco-
nd methyl alcohol. The aqueous and alco-
solutions are deep orange in colour. The
us solution has been found to give cha-
istic colours in acidic and alkaline media
ig orange in acid and yellow in alkaline
ons. Further, a few drops of 1 per cent.
us solution of this compound can serve
ensitive indicator for acid-base titrations.
y be used in titrations of strong acids
t strong alkalies and weak acids against
alkalies. The titre values were the same
se obtained when methyl orange and
phthalein were employed as indicators.
lour changes have been found to be com-
vithin a pH range of 6·4 to 7·6. The pH
of its 1 per cent. aqueous solution at
is 3·0.

ay be pointed out that freshly prepared
sation products of d-camphor-10-sulpho-
d with m- and p-phenylenediamines do
w colour variations with changes in pH
medium. The analytical data shows that
wo salts belong to the normal form (I).
enylenediamine salt: m.p. 168-69° C.,
C, 59·78; H, 6·65; N, 9·02; S, 9·73.
N₂O₃S requires C, 59·62; H, 6·08;
); S, 9·94. m-Phenylenediamine salt:
73-75° d. Found: C, 56·83; H, 6·76;
); S, 9·58. p-Phenylenediamine salt:
30-85° d. Found: C, 56·72; H, 7·43;
S, 9·27. C₁₆H₂₄N₂O₄S requires C, 56·46;
; N, 8·23; S, 9·41.)
eartiest thanks are due to Dr. A. K.
arya for providing research facilities.

MAGHAR SINGH MANHAS.
ARVIND VINAYAK MAHAJANI.
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ty of Saugar,
.P., *April* 16, 1953.

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## AN ANTI-B BLOOD GROUPING REAGENT PREPARED FROM SOYA BEANS

NON-SPECIFIC agglutinins for human red cells
are present in soya beans (*Glycine soja*).[1] The
agglutinins are active at low temperatures
(6-10° C.) but not at laboratory temperature
(30° C.).

When absorbed with O cells in the cold, the
action of these agglutinins upon A and B cells
is increased both in titre and in thermal ampli-
tude. A and B cells are now agglutinated at
laboratory temperatures. Absorption with A
cells results in loss of activity for both A and
O cells with enhanced activity against B cells.
Similarly, absorption with B cells results in
loss of activity for both B and O cells with
enhanced activity for A cells.

The antibodies present appear to be a combi-
nation of anti-H, anti-A and anti-B. The en-
hanced action against A and B cells is similar
to that observed in certain human sera con-
taining cold agglutinins predominantly specific
for O cells.[2,3]

So far specific anti-A and anti-O antibodies
have been demonstrated in certain seeds. No
seed antibodies specific for B cells have been
described. Attempts to prepare a specific anti-B
reagent from seeds containing non-specific ag-
glutinins by absorbing them with O and A cells
have resulted in the removal of all agglutinins.

However, complete absorption of *Glycine soja*
extracts, prepared as previously described,[4]
with O and A cells yields a reagent specific for
B cells. This absorbed extract agglutinates B
cells to a titre of 2 by the tile method, and 32
by the tube method, at laboratory tempera-
ture. All of 100 samples of B cells were strongly
agglutinated at laboratory temperature. Con-
trol A and O cells were consistently negative
or very weakly positive at 4-6° C.

As the reagent is prepared by an absorption
method and has a low titre it is doubtful if it
will find favour as a routine blood-grouping
reagent. A detailed report, dealing particularly
with the phenomenon of the post-absorption
enhancement, will appear elsewhere. This phe-
nomenon is considered to be of possible import-
ance in studies of antibody properties.

Blood Transfusion Dept.,          G. W. G. BIRD.
Armed Forces Medical College,
Poona, *October* 22, 1953.

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## THE NUTRITIVE VALUE OF DIFFERENT VARIETIES OF SWEET POTATO

SWEET POTATO (*Ipomea batatas*), believed to be a native of South America, is now cultivated throughout the tropics and subtropics and in some temperate regions. The varieties commonly grown are of two types : one having orange flesh and the other white.[1] The white flesh variety is widely cultivated in India, while in U.S.A. the orange variety is widely grown and consumed.[2] Recently, attempts have been made to grow the orange flesh variety of sweet potato in experimental farms in India.[3] The present paper deals with the chemical composition of three American orange flesh varieties and two local white flesh varieties.

supplying us the different varieties of sweet potato, and to Dr. V. Subrahmanyan, Director of this Institute, for his keen interest in this work.

Central Food Tech.      H. B. N. MURTHY.

Res. Institute,      M. SWAMINATHAN.

Mysore, *June* 1, 1953.

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TABLE I

*Chemical composition of different varieties of sweet potato*

| Variety | Moisture % | Protein % | Fat % | Fibre % | Mineral matter % | Carbohydrate % (by difference) | Calorific value per 100 g. | Calcium mg. % | Phosphorus mg. % | Carotene mg. % |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Local variety, pink skin (white flesh) | 66·8 | 1·5 | 0·3 | 1·6 | 1·0 | 28·8 | 124 | 34·5 | 62·2 | nil |
| 2 Local variety, white skin (white flesh) | 65·6 | 2·6 | 0·4 | 1·7 | 1·3 | 28·4 | 128 | 72·0 | 74·6 | nil |
| 3 American variety (orange flesh) 5999 | 71·5 | 2·8 | 0·3 | 1·4 | 1·0 | 23·0 | 106 | 101·6 | 71·5 | 7·2 |
| 4 American variety (orange flesh) 5941 B | 73·2 | 2·6 | 0·2 | 1·3 | 0·9 | 21·8 | 99 | 104·8 | 72·1 | 5·4 |
| 5 American variety (orange flesh) L 240 | 70·5 | 3·1 | 0·3 | 1·4 | 1·0 | 23·7 | 110 | 52·0 | 68·4 | 5·8 |

The sweet potato used in these studies was grown in Bangalore. The samples were received in good condition immediately after harvesting. The determination of the proximate principles and minerals were carried out by the methods of A.O.A.C.[4] Carotene was determined according to the method of the Association of Vitamin Chemists.[5] The results are presented in Table I.

It is evident from the results that the American varieties of sweet potato are very rich in carotene in contrast to the local varieties, which are completely devoid of the same. Attempts are being made to increase the cultivation of sweet potato in order to utilize it as a subsidiary food.[6] It would appear from the results that introduction of the American varieties in preference to the local varieties would help to improve the nutritional quality of our diet, particularly the vitamin A content.

Our thanks are due to the Superintendent of the Lal Bagh Gardens, Bangalore, for kindly

## MORPHOLOGY OF THE COMMON INDIAN HOUSE-FLY, *MUSCA* (S. STR.) *DOMESTICA NEBULO* FABRICIUS

WEST[1] has reviewed the work done on different house-flies. Some of the significant observations on the morphology of the Indian house-fly are incorporated in this note.

(1) The body of the male is more setose. (2) The thoracic stripes in the male are fused on the scutellum, whereas they are free in the female. (3) The abdominal stripe of the male is broader and complete.

In both the sexes, the compound eyes, possess, along with the hexagonal ommatidia, a variable number of square ommatidia, arranged in rows of four, only in the central region of the eye. The labellum bears 33 pseudotracheæ, which are arranged in sets of 3. The anterior set consists of 10 pseudotracheæ, the central of 6 and the posterior of 17. Two malpighian tubules are situated at the junction of the

proximal and distal intestines. There are 4 rectal glands. Each is conical with a swollen, circular perforated base, which is in continuation with the wall of the rectum.

The male has 2 pairs of thoraic and 7 pairs of abdominal spiracles, while the female has 2 pairs of thoraic and 5 pairs of apparent abdominal spiracles. All the 3 thoracic nerve ganglia fuse to form a compound ganglion. The abdominal ganglion lies touching this, and sends posteriorly the abdominal nerve. No accessory glands are present in the male. The female has 3 spermathecæ, a pair of accessory glands, and the copulatory pouches. Two spermathecæ are on the left side and one on the right, held together by a thin-walled sac, their ducts opening near the posterior end of the sacculus.

Further details are being published elsewhere.

We are thankful to the Director, M.A.C.S. Laboratory, Poona, for the facilities placed at our disposal to conduct these studies during 1949-51.

Haffkine Institute,    P. J. Deoras.
Parel, Bombay-12,    D. R. Ranade.
*November* 11, 1953.

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## INFLUENCE OF FEEDING PENICILLIN ON INTESTINAL THIAMINE SYNTHESIS

Recent studies[1-8] indicate that feeding certain antibiotics stimulates the growth of rats and other experimental animals particularly when the basal diet contains limiting amounts of B-complex vitamins. The effect of these drugs on the intestinal flora of the animals has also been studied to some extent.[9-13] We carried out some studies to determine the mechanism of growth-promoting action of the antibiotic and its influence on thiamine synthesis. These observations are reported here.

Twenty-four rats weighing about 50 g. each were divided into four comparable groups (A, B, C and D) of six rats each. Rats of A and B groups were given a poor South Indian diet.[14] Animals of C and D groups were fed a synthetic diet consisting of starch (64 per cent.), sugar (10 per cent.), vitamin-free casein (12 per cent.), salt mixture (4 per cent.) and groundnut oil (10 per cent.). Daily vitamin $B_1$ intake of each rat was restricted to 5 gamma in all the groups. Each rat received daily 50 gamma of riboflavin, 50 gamma of calcium pantothenate, 10 gamma of nicotinic acid, 10 gamma of pyridoxine and 1 mg. of choline. Two drops of adexolin were supplied to each rat twice a week. Penicillin, mixed with the diets, was fed to the rats of B and D groups at a level of 0·5 mg. per rat per day. Weekly growth rates, urinary and fæcal thiamine excretions, liver stores of thiamine and fæcal and cæcal flora of the different groups of animals were followed. The methods employed for the estimation of thiamine in urine, fæces and liver were those of Mawson and Thompson,[15] 'Vitamin Assay'[16] and Greenberg and Rinehart[17] respectively. Enzyme digestion using takadiastase was carried out in the cases of fæces and liver.

The techniques of Miller[18] and Nath[19] *et al.* were adopted for the bacteriological examination of the fæcal flora and cæcal flora respectively.

The results obtained are summarised in the following table.

TABLE

| Data | Poor South Indian diet | P.S.I.D.+ penicillin | Synthetic diet | Synthetic diet + penicillin |
|---|---|---|---|---|
| 1 Net increase in wt. (6 weeks) g. | 21·3±0·7 | 36·7±0·6 | 38·8±0·8 | 66·2±1·1 |
| 2 Weekly excretion of thiamine (gamma) | | | | |
| urine | 3·5±0·2 | 5·7±0·2 | 6·0±0·2 | 10·2±0·3 |
| Total fæces | 3·4±0·1 | 5·6±0·1 | 2·8±0·2 | 5·2±0·2 |
| 3 Liver thiamine in gamma | 3·1±0·1 | 5·0±0·2 | 3·8±0·1 | 6·5±0·3 |
| 4 Fæcal flora:—Total counts/g. of fæces in $10^5$ | 12·7 | 6·2 | 17·3 | 7·3 |
| Coliform counts/g. of fæces in $10^4$ | 13·3 | 11·7 | 11·7 | 12·0 |
| 5 Cæcal flora:—Total counts/g. of cæcal contents in $10^6$ | 2·6 | 1·1 | 3·0 | 1·4 |
| Coliform counts/g. of cæcal contents in $10^5$ | 1·3 | 1·1 | 7·0 | 7·8 |

It could be seen that oral administration of penicillin has resulted in marked growth stimulation, enhanced thiamine excretions and also higher liver thiamine stores as compared to the control groups.

A consideration of the fæcal and cæcal flora indicates that the increased benefit derived by the groups of rats fed penicillin is perhaps not due to increased thiamine synthesis as the coliform organisms have not recorded any increase. *In vitro* studies were carried out to elucidate whether as a result of penicillin treatment, even without substantial increase in the number, the coliform bacteria were toned up to synthesise more thiamine or whether penicillin killed out other bacteria competing with the host for the available thiamine. The total count of the fæces and cæcal contents recorded in the table shows that the mechanism of the antibiotic action is by eliminating the thiamine utilising bacteria, thereby making available to the host the entire thiamine supplied in the diet and also synthesised in the intestinal tract. The *in vitro* studies have given convincing evidence to the fact that there is no increased synthesis of thiamine due to penicillin feeding and that consequent on the reduction of the other types of bacteria, the rat has had more thiamine for its growth. Studies were also carried out to find out whether parenteral administration of penicillin would evoke similar response. It was found that such a method had no beneficial influence. The detailed paper will be published elsewhere.

The authors' thanks are due to Prof. K. V. Giri for his keen interest in this investigation.

Dept. of Biochem. and          S. BALAKRISHNAN.
  Pharmacology Lab.,          R. RAJAGOPALAN.
Indian Inst. of Science,          M. SIRSI.
Bangalore-3, *October* 19, 1953.

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## ROLE OF PYRIDOXINE IN TRYPTOPHANE METABOLISM STUDIED IN RICE MOTH LARVA (*CORCYRA CEPHALONICA* ST.)

PYRIDOXINE deficiency was found by Lepkovsky and Nielson[1] and then by Miller and Baumann,[2] to produce marked alterations in tryptophane metabolism. Later studies[3,4] showed that pyridoxine deficient rats were unable to convert appreciable amounts of added tryptophane to nicotinic acid and its derivatives. Using desoxypyridoxine—the anti-vitamin of pyridoxine—Shanmuga Sundaram, Ranganathan and Sarma[5] showed that pyridoxine had a definite role to play in the conversion of tryptophane to nicotinic acid in germinating pulses. Much work had been carried out using insects regarding the role of tryptophane metabolites in the production of eye pigments by Butenandt and his co-workers.[6,7,8] In the case of rice moth larva, Sarma[9] found that pyridoxine was one of the growth-promoting factors and that a yellow coloured compound was excreted when the rice moth larvæ were fed pyridoxine deficient diets containing tryptophane. The yellow-coloured compound disappeared from the excreta on the addition of pyridoxine to the diet. The yellow compound did not answer the tests for xanthurenic acid. In order, therefore, to obtain further information on the role of pyridoxine in tryptophane metabolism in rice moth larva, a study was made on the total nicotinic acid present in the pyridoxine deficient and supplemented whole larvæ, which were fed either tryptophane or kynurenine, or 3-hydroxy anthranilic acid.

The basal diet was prepared as described by Sarma.[9] The pyridoxine deficient diet consisted of salt extracted wheat flour, sugar and salt mixture, together with vitamins thiamine, riboflavin and calcium pantothenate in the proportion 10, 5, 15 $\mu$g. per gram of the diet respectively. As the conversion of tryptophane and its metabolites to nicotinic acid is to be studied by estimating the total nicotinic acid in the larvæ, no

nicotinic acid was added to the diet. DL-trypto-phane, DL-kynurenine sulphate and 3-hydroxy anthranilic acid were added to the diet at a level of 10, 5 and 3 mg. per g. of the diet respectively. The larvæ which were feeding on whole wheat diet for a period of 10-12 days after hatching were removed, cleaned, weighed and placed in the pyridoxine deficient and supplemented diets containing tryptophane or its metabolites. They were picked out at regular intervals, weighed, crushed and hydrolysed with 1 N sulphuric acid for 45 minutes in an autoclave at 15 lb. pressure. The total nicotinic acid was estimated by the microbiological method of Snell and Wright.[10]

That rice moth larva, normally synthesises nicotinic acid, as it grows on a whole wheat diet can be seen from Fig. 1. Table I gives the amount of nicotinic acid synthesised by pyridoxine deficient and supplemented larvæ fed tryptophane, or kynurenine or 3-hydroxy anthranilic acid. From the results presented, it can be seen that in the case of pyridoxine deficient larva fed tryptophane and kynurenine the total nicotinic acid is much less than that contained in pyridoxine fed larva, showing thereby that pyridoxine deficient larvæ are unable to convert appreciable amounts of added tryptophane and kynurenine to nicotinic acid. Further, in these two cases the larvæ excrete yellow-coloured fæces. However, in the case of pyridoxine deficient and supplemented larvæ fed 3-hydroxy anthranilic acid, the total nicotinic acid content are the same and no yellow-colour-

ed compound is excreted. As the yellow-coloured compound is not found to be xanthurenic acid confirming the earlier observations of Sarma,[9] it is suggested that it may be 3-hydroxy kynurenine, which may be excreted out, as it
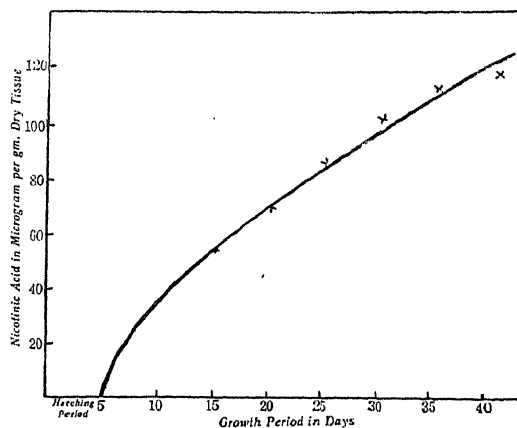


FIG. 1 Graph showing the synthesis of nicotinic acid by the rice moth larva reared on whole wheat flour.

gets accumulated during the deficiency state. From these, it is clear that the rice moth larva behaves in a manner analogous to mammals and the fungus *Neurospora crassa*, as regards tryptophane metabolism. Here also pyridoxine is concerned and its site of action from the data given is in between kynurenine and 3-hydroxy anthranilic acid. However, using circular paper chromatographic technique, it has been found qualitatively that the yellow-coloured compound

TABLE I

*Nicotinic acid content of pyridoxine deficient and supplemented rice moth larva, fed trypto-phane or kynurenine or 3-hydroxy anthranilicacid*

| Number of days in the experimental diet | DL-tryptophane 10 mg. per g. | | * DL-kynurenine 5 mg. per g. | | † 3-Hydroxy anthranilic acid 3 mg. per g. | |
|---|---|---|---|---|---|---|
| | Average weight of 20 larvæ mg. | Nicotinic acid gamma per g. dry weight | Average weight of 20 larvæ mg. | Nicotinic acid gamma per g. dry weight | Average weight of 20 larvæ mg. | Nicotinic acid gamma per g. dry weight |
| Larva on pyridoxine added diet | | | | | | |
| 10 | 326 | 61·12 | 320 | 64·0 | 315 | 66·0 |
| 20 | 425 | 78·40 | 420 | 74·8 | 480 | 96·4 |
| 25 | 445 | 87·60 | 465 | 91·0 | 530 | 102·0 |
| Larva on pyridoxine deficient diet | | | | | | |
| 10 | 211 | 44·60 | 240 | 46·0 | 302 | 63·2 |
| 20 | 270 | 53·60 | 295 | 58·0 | 430 | 90·5 |
| 25 | 291 | 59·20 | 320 | 63·0 | 480 | 94·0 |
| | (Yellow excreta) | | (Yellow excreta) | | (No yellow excreta) | |

is 3-hydroxykynurenine.[11] Final confirmation should, however, await the actual isolation of 3-hydroxykynurenine from the yellow excreta in a pure state, but it can now be said definitely from the investigations detailed above that the site of action of pyridoxine is in between 3-hydroxykynurenine and 3-hydroxyanthranilic acid, in the rice moth larva.

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## THE CHROMOSOME NUMBER OF *RHODOTORULA GLUTINIS* AND ITS PROBABLE SIGNIFICANCE

Like the *Torulæ*, the *Rhodotorulæ* also have generally been assumed to be haploids because they are asporogenous.[1,2] It was shown recently[3] that the mitotic complement of *Candida utilis* consists of two chromosomes. Because a sporogenous brewery yeast was demonstrated earlier[4,5,6] to have the same chromosome number, it was suggested that *Candida utilis* may be a diploid hybrid. On the same argument, it appeared to us that *Rhodotorulæ* may also be infertile diploid hybrids. To settle this question, the cytology of *Rhodotorula glutinis* (Fres.) Harrison var. *rubescens* (Saito) Lodder was investigated.

Mitosis is just one phase of behaviour of the yeast nucleus[7] and is exhibited only under certain specified conditions. Its demonstration, therefore, necessitates considerable experimentation and as such is not as easy as in the higher organisms. The nucleus is defined[8] as "a cell body reproducing by mitosis" (p. 499). The fact that chromosomes are Feulgen-positive being a later discovery, identification of a nucleus in yeast should be by an investigation of *normal mitosis*, preferably in Feulgen preparations. In the absence of such proof, differences of opinion between investigators in the same laboratory[9,10,11] are only to be expected. Conclusions[11] drawn from the size of Feulgen-positive bodies in the so-called haploid, diploid and polyploid types would remain questionable so long as the identification of such structures as "nuclei" remain arbitrary.

To identify certain bodies in the yeast cell unequivocally as chromosomes, it should be shown that (1) they originate as a result of the resolution of the nucleus at the beginning of mitosis[8] (p. 495); (2) they reproduce; (3) the daughter chromosomes are distributed equally to the mother cell and bud; and (4) it is these that reconstitute into nuclei at the end of mitosis.
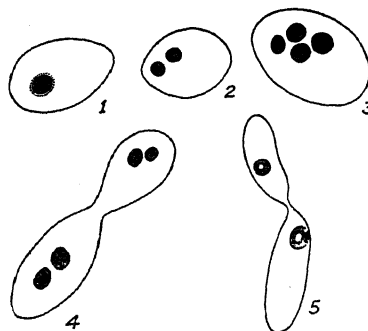


FIG. A (1–5) : 1. 3·6 $\mu$ (Longest diameter). 2. 2·7 $\mu$. 3. 3·6 $\mu$ 4·9·0 $\mu$ (Mother cell and bud). 5. 9·0 $\mu$ (Mother cell and bud).

The photomicrographs presented are from smears fixed in $OsO_4$ vapour and stained by the Feulgen technique.[12] No Feulgen-positive structures are visible during the interphase. When a cell starts on its mitotic cycle, a small chromatin grain appears inside a clear unstained area (Fig. A, 1; Fig. B, 1). Though small at the beginning, it enlarges in size and gives rise by division (cf.[4,5,6]) to the two chromosomes of early metaphase (Fig. A, 2; Fig. B, 2). The reproduction of the chromosomes at full metaphase is indicated by a constriction making each of them double. The daughter chromosomes begin to separate (Fig. A, 3; Fig. B, 3) into two groups of equal numbers and at late anaphase (Fig. A, 4; Fig. B, 4) mother cell and bud show two chromosomes each. The reconstituted nuclei of the telophase are illustrated in Fig. A, 5; Fig. B, 5.

*R. glutinis* has, therefore, two chromosomes. Is it a haploid or a diploid ? It has been claimed recently[11,13] that identification of diploids and auto-tetraploids by a study of their chromo-

some number should be confirmed by genetic analysis. This would appear rather strange to those familiar with the literature on the induction of polyploidy by chemical agencies.[14] Historically, the discovery of polyploidy preceded[8]
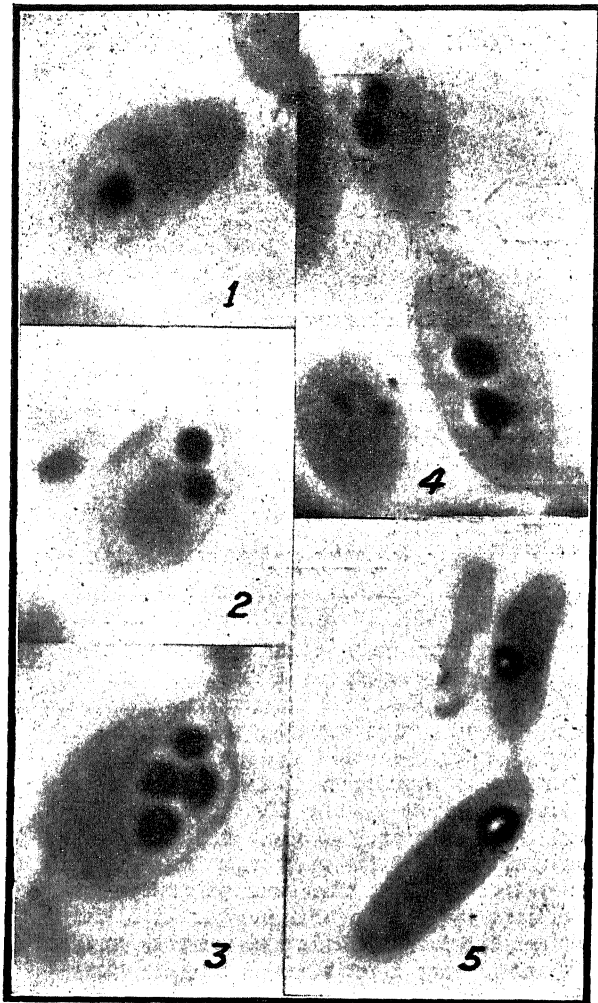


FIG. B

the analysis of the genetic behaviour of such types. The definition of a polyploid[8] as "an organism with more than two sets of homologous chromosomes" (p. 499) is based purely on chromosome counts without any reference to its genetic behaviour. Identification of polyploids on genetic grounds[11,13] require, on the other hand, cytological confirmation for their acceptance.

Genetic methods have their own limitations[15] especially when the form is an octo- or 16-ploid. They cannot also help in elucidating whether an asporogenous yeast is a haploid or a diploid.

Once the chromosome number is known, a comparison with other sporogenous types would indicate whether the form in question is a haploid or a sterile diploid. *R. glutinis* shows a remarkable similarity in the number and behaviour of its chromosomes to the sporogenous brewery yeast, BY 1.[4,5,6] The theoretically minimum number of chromosomes necessary for normal sporulation is only two. It appears justifiable, therefore, to conclude that *R. glutinis* may be a sterile diploid.

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## THE POSSIBLE EXPANSION OF THE VALENCE SHELL OF SULPHUR IN HYPERCONJUGATED STRUCTURES

IN the course of an investigation on the activating influence of a sulphur atom on the adjacent methylene group, we have found that arylthioglycollic acids condense with aromatic aldehydes on heating with catalytic amounts of piperidine and ammonium acetate in glacial acetic acid for 4-12 hours. For example, the condensation of phenylthioglycollic acid (I) with benzaldehyde gave α-phenylmercaptocinnamic acid (II). Its m.p. 142-143° C. agrees with that reported by Papa and Schwenk[1] (Found: C, 70·34; H, 4·60; $C_{15}H_{12}O_2S$ requires C, 70·33; H, 4·69 per cent.).

$$\langle\!\!\bigcirc\!\!\rangle - S - CH_2COOH + OHC.C_6H_5 \longrightarrow \langle\!\!\bigcirc\!\!\rangle - S - \underset{\overset{|}{\text{COOH}}}{C} = CH.C_6H_5$$

(I)                               (II)

$$\langle\!\!\bigcirc\!\!\rangle = \overset{..}{S} = \underset{H^+}{CH} - COOH \qquad -\langle\!\!\bigcirc\!\!\rangle = \overset{..}{S} = \underset{H^+}{CH} - COOH \qquad \langle\!\!\bigcirc\!\!\rangle = \overset{..}{S} = \underset{H^+}{CH} - COOH$$

(III)                     (IV)                       (V)

$$\langle\!\!\bigcirc\!\!\rangle - \overset{..}{S} = \underset{H^+}{\overset{\overset{\displaystyle H}{|}}{C}} - COOH \qquad \langle\!\!\bigcirc\!\!\rangle - \overset{..}{S} = \underset{\overset{|}{H}}{\overset{H^+}{C}} - COOH$$

(VI)                          (VII)
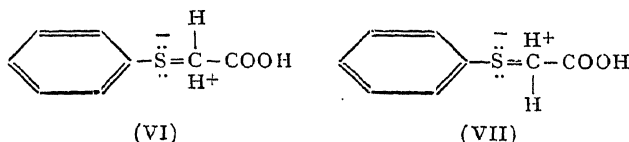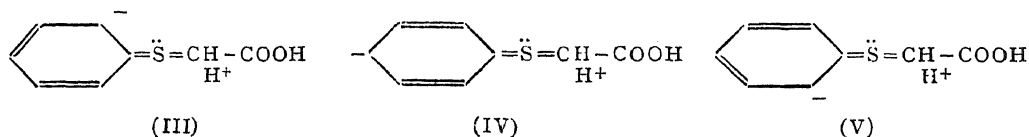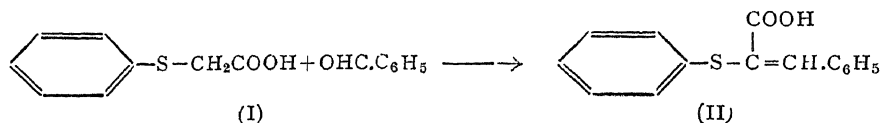
The condensation, however, failed to occur when phenylthioglycollic acid was replaced either by alkylthioglycollic acids or by phenoxyacetic acid. Phenylthioglycollic acid and phenoxyacetic acid were recently condensed with benzaldehyde by Papa and Schwenk[1] under the conditions of the Perkin reaction. The condensation was effected at 105–115° C. in 48 hours. They obtained the pure condensation products in 22 per cent. and 34 per cent. yields from phenoxyacetic acid and phenylthioglycollic acid respectively. The smaller yield with phenoxyacetic acid in the Perkin reaction and the non-reactivity of phenoxyacetic acid with benzaldehyde under the conditions of the present modified procedure indicate that the -CH₂- group in phenoxyacetic acid is less reactive than that in phenylthioglycollic acid. If the activation of the -CH₂- group is partly due to the carboxyl group and partly due to the inductive electron attraction of the oxygen or sulphur atom, $C_6H_5.O.CH_2.COOH$ should be expected to condense more readily than $C_6H_5.S.CH_2.COOH$ since the inductive effect of the oxygen atom is greater than that of the sulphur atom. But the order of reactivity has been found to be reversed. Hence it seems to be highly probable that hyperconjugated structures of the type III, IV and V, made possible by the expansion of the valence shell of the sulphur atom, make significant contributions to the resting state of phenylthioglycollic acid. Such expansion of the valence shell is not possible in the case of oxygen atom.

Structures such as VI and VII, which are analogous to those suggested for mercaptals by Rothstein,[2] may also be proposed. But then alkylthioglycollic acids should be as reactive as phenylthioglycollic acid. The fact that they are less reactive than phenylthioglycollic acid makes the contributions of structures VI and VII less significant.

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## VARIETAL RESISTANCE OF WHEAT TO LOOSE SMUT (*USTILAGO TRITICI*)

TWENTY-TWO promising varieties of wheat were tested for their resistance to loose smut during 1951-52 and 1952-53 at Government Research Farm, Kanpur. The varieties were inoculated with spore suspension (1 gm. smut powder in 1 litre water) during their flowering stage by "vacuum method" in the late afternoon. The seeds obtained from the inoculated heads were sown in rows of 20' on two dates with an interval of 20 days. The smut percentage was calculated by counting the number of healthy and smutted heads. The wheat varieties on the basis of average smut infection may be grouped as follows :

Resistant (Below 1 per cent. infection)—Bansi Pali 808, Bansi CP., N.P.710.

Moderately susceptible (Below 10 per cent. infection)—Pb9D, N.P.165, Pb228.

Susceptible (Above 10 per cent. infection)— Pb8A, Padawa I, N.P.720, N.P.125, Pb518, A.O.68, C46, N.P.773, Pb591, N.P.52, Padawa II, N.P.775, Pb281, C13, N.P.4, N.P.12.

Late sowing exhibited greater smut infection in each of the varieties as compared to normal sowing. Most of the susceptible varieties showed from 40 to 76 per cent. infection in late sowing and from 15 to 36 per cent. in normal sowing during 1951-52.

We are grateful to Dr. A. K. Mitra for supplying the wheat varieties.

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## PREPARATION OF WHOLE MOUNTS OF LARVAE OF SUGARCANE MOTH BORERS TO STUDY THEIR TRACHEAL SYSTEM

Very little information is available regarding the technique for preparing whole mounts of insects in order to study their tracheal system. The only work of some importance on the subject seems to be that of Roonwal,[1] who mounted white-fly nymphs in glycerine and in de Faure's chloral hydrate medium to demonstrate tracheæ. The tracheæ remained clear and silvery for some hours, after which the mounting medium penetrated the tracheal tubes. The present note describes a new techniqce by means of which the tracheal system of the larvæ of sugarcane moth borers can be made very clear and studied in permanent whole mounts which can be projected on the screen.

The technique consists in killing the experimental specimens by immersion in strong alcohol followed by fixing in 70 per cent. alcohol for a week (as a result of which the two lateral tracheal trunks with their branches become hardened and fixed) and their subsequent immersion in a strong solution of KOH for about 24 hours. This is followed by a thorough washing with water for 8-12 hours, after which the specimens are treated with diaphanol for bleaching and softening the chitin. They are again washed with water and gradually pressed in between two glass slides one by one. As a result of this manipulation, the internal organs of the larvæ are eliminated, only the lateral tracheal trunks with their branches attached to the body wall being left behind. The specimens fixed in units of two slides as explained above and fastened together at their two ends by means of clips, are placed in a staining jar containing methylated spirits for about 20 minutes. They now adopt the required shape and the slides are carefully separated to transfer the specimens to a watch glass containing fresh alcohol. They are then washed in several changes of fresh alcohol, and brushed carefully with a fine camel hair brush to remove any debris clinging to their surface. They are thereafter stained with eosin in 90 per cent. alcohol and upgraded after which they are kept immersed in turpentine oil to which

has been added phenol (heated until fluid) in the ratio of 3 phenol to 5 turpentine. After 24 hours they are taken out and cleared first in pure turpentine oil to get rid of the last traces of phenol and then in cedarwood oil. Finally, the treated specimens are mounted in canada balsam. Fig. 1 is a photographic reproduction



KEY TO THE LETTERING:—
D.COM. DORSAL COMMISSURE
L.T.T. LATERAL TRACHEAL TRUNK
SP. SPIRACLE
V.COM. VENTRAL COMMISSURE
V.T. VISCERAL TRACHEAE
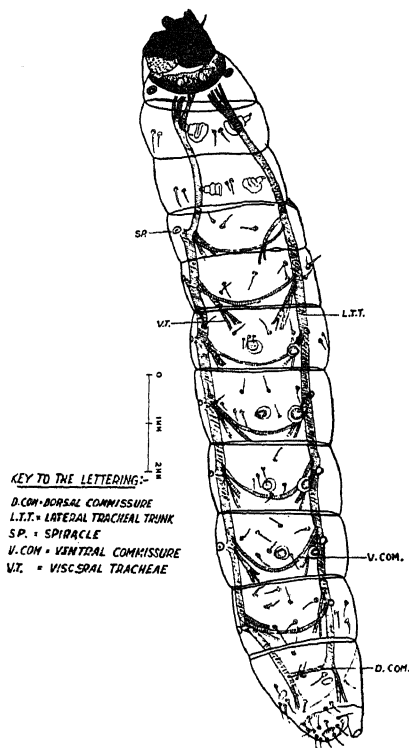
FIG. 1

of a camera lucida drawing from a permanent slide of sugarcane stem borer *Argyria sticticraspis,* prepared by the technique described above and clearly shows the position of the spiracles and the two lateral tracheal trunks with their main branches duly labelled. Further details of this work will be published elsewhere.

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Pusa, Bihar, *September* 18, 1953.

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## TANYMECUS INDICUS FST., A NEW CURCULIONID PEST OF PADDY WITH SUGGESTIONS FOR ITS CONTROL

IN July 1953, severe and extensive damage to *Aman* paddy seedlings was reported by the cultivators of Amjhora Union, in the District of 24 Parganas, West Bengal. The beetle responsible for the damage was subsequently identified as *Tanymecus indicus* Fst., belonging to the subfamily, Brachyderinæ, of the family Curculionidæ.

The species *indicus* was first described by Faust[1] in 1894 from Bengal. The species has hitherto been recorded as a pest of a number of important agricultural crops among which however, paddy is not included.[2,3] Hence the authors record it for the first time as a pest of paddy.

The genus *Tanymecus* comprises a large number of species with a wide range of geographical distribution and many of them have been recorded as pests of agricultural crops of economic importance.

The insects are greyish black in colour, measuring about 6 mm. in length. Eyes large. Rostrum with a distinct central ridge and a very shallow curved indentation at the apex. Prothorax leathery, a little longer than broad with rounded sides, not constricted near apex and with a faint trace of a central ridge on the anterior half. Elytra densely scaled with lines of punctures in grooves, very gradually tapering behind with the apices divergently pointed. Legs black with fairly dense scaling, the tibiæ not denticulate internally (Fig. 1).
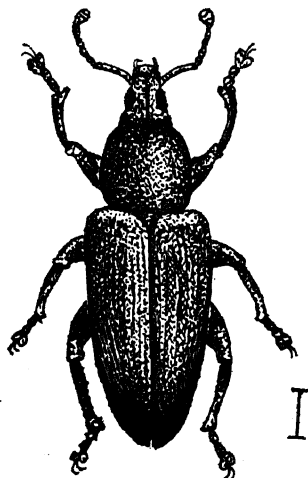


FIG. 1    *Tanymecus indicus* Fst.

The insect, popularly known in Northern India as "Godela", has long established itself as a serious pest of newly germinating *rabi* crops, particularly wheat, gram and pea, and less frequently barley and poppy. The paddy seedlings were affected in the seed-beds within the first 15-20 days of development. The affected plants dried up rapidly without giving any indication of external injury by insects. But when pulled out of the soil the underground portions of the stems, lying just above the roots, were found to be badly damaged due to the nibbling of these insects, resulting in partial or complete detachment of the stems from the roots (Fig. 2).
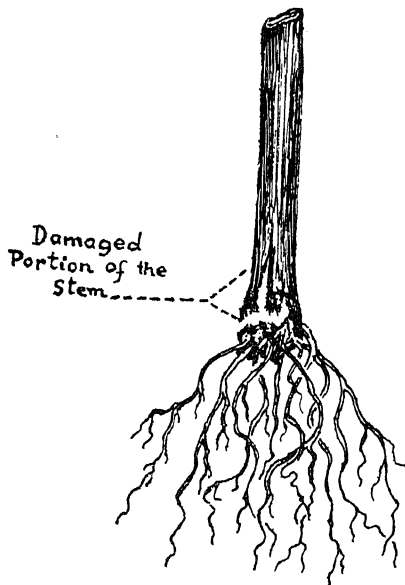


FIG. 2   Damage caused to paddy plants by *T. indicus*.

Besides the adults, the larvæ of this insect found in the soil also played a great part in the ravage.

For the control of these insects, the authors suggested the flooding of the seed-beds with a view to compel them to come above the level of water, when it would be easy to apply insecticides against them. The measure yielded immediate results and the attack subsided within a week.

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Calcutta, October 1953.

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## FEMALE GAMETOPHYTE, ENDOSPERM AND EMBRYO OF *LYSIANA EXOCARPI* (BEHR.) VAN TIEGHEM

ALTHOUGH considerable embryological work has been done on the Loranthoideæ, *Lysiana exocarpi* has not yet received any attention. My observations, based on material of this plant obtained from Australia, have shown some features of interest which are worthy of mention.

In a young bud a mound-shaped projection, the mamelon, arises from the base of the ovarian cavity (Fig. 1). In a transverse section it appears 4-lobed and is fused with the ovarian wall between the lobes making the ovary 4-chambered (Fig. 2). During further growth the apex of the mamelon reaches up to the base of the style. Though ovules in the usual sense are absent, each lobe of the mamelon may be said to represent a greatly reduced ovule.

In each lobe of the mamelon 3-4 hypodermal layers differentiate into archesporial cells. The latter elongate diagonally, become spindle-shaped and directly function as megaspore mother cells (Fig. 5). Linear tetrads of mega-
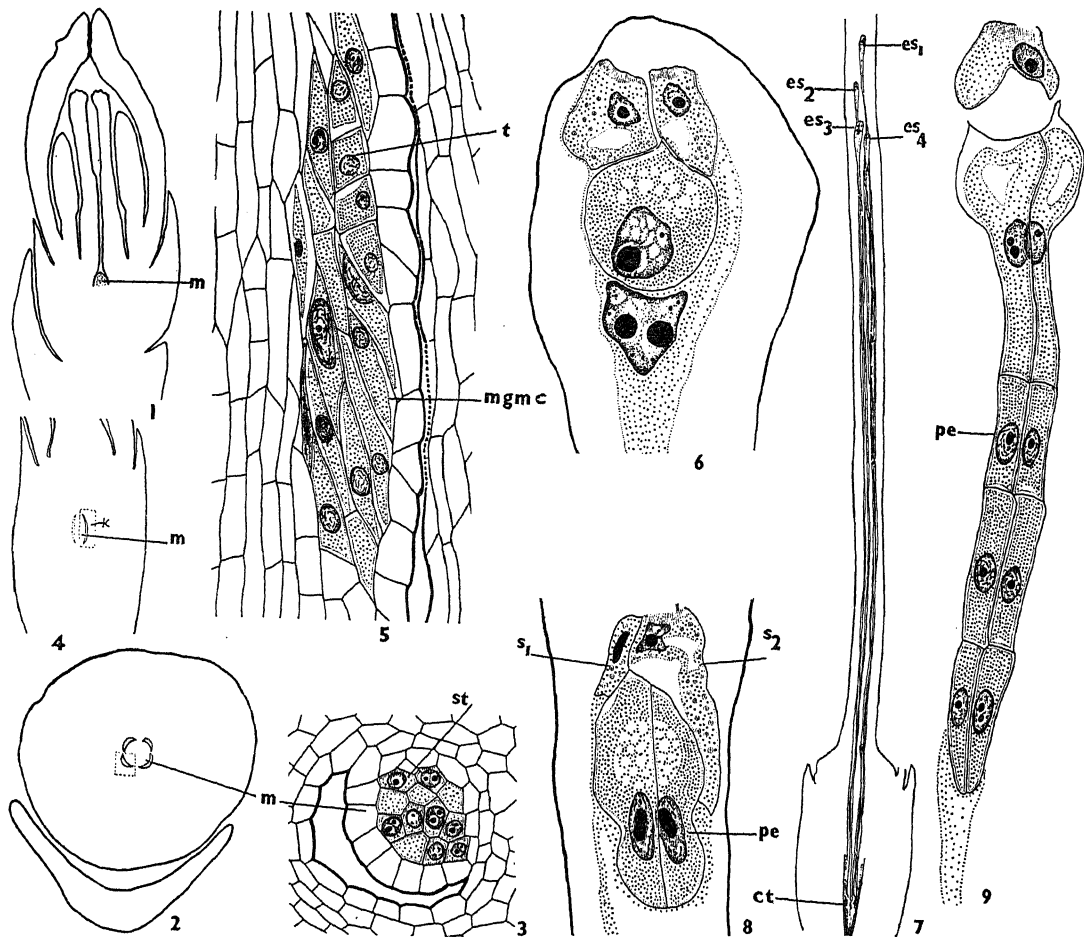


FIGS. 1–9.

Fig. 1. L.S. young bud showing mamelon (diagrammatic). Fig. 2. T.S. ovary showing the 4 lobes of the mamelon, × 7. Fig. 3. Hypodermal archesporium in a lobe of the mamelon enlarged from Fig. 2, × 298. Fig. 4. L.S. ovary showing the lobes of the mamelon, × 5. Fig. 5. Enlarged view of portion marked *K* in Fig. 4 to show mother cells and tetrads, × 298. Fig. 6. Tip of mature embryo sac showing egg apparatus and secondary nucleus, × 288. Fig. 7. Outline figure to indicate the height to which the embryo sacs grow in the style (diagrammatic). Fig. 8. First division of zygote, × 288. Fig. 9. Biseriate pro-embryo, × 288.

(*ct*—collenchymatous tube; *es*—embryo sac; *mgmc*—megaspore mother cells; *pe*—pro-embryo; *s*—synergid; *st*—sporogenous tissue; *t*—tetrad).

*Letters to the Editor*

spores are formed. Many of the mother cells, particularly those situated towards the central axis of the mamelon, become arrested and degenerate. At this stage a U-shaped collenchymatous tube becomes distinguishable below the mamelon.

Usually the basal megaspore of the tetrad, i.e., the one situated towards the base of the ovary, functions but the two middle ones may also develop up to the 2-nucleate stage. The 4-nucleate embryo sac elongates considerably and destroys the tissue lying in its way. The upper end with the two nuclei reaches up to the middle of the 45-50 mm. long style. One further division of these nuclei leads to the formation of a normal egg apparatus and the upper polar nucleus. The lower end of the embryo sac grows down to the base of the collenchymatous tube. I could not follow the divisions of the lower two nuclei or observe the antipodals but the lower polar nucleus was invariably present. It could not be confirmed if any cæcum is formed (as in *Macrosolen*).[2] Three to five embryo sacs develop simultaneously in the stylar tissue.

The lower polar nucleus migrates to the upper part of the embryo sac where it fuses with the upper polar nucleus. The primary endosperm nucleus descends to the lower end of the embryo sac where it gives rise to a cellular endosperm. Finally the endosperms of all the embryo sacs in an ovary fuse to form a composite mass. The mature endosperm which shows 5-6 deep peripheral furrows, is narrow and truncated at the base, broadens in the middle and narrows again into 5-6 conical teeth-like structures at the apex.

The zygote elongates and undergoes a vertical division followed by transverse divisions resulting in a biseriate pro-embryo (Figs. 8, 9). Three to five pro-embryos develop in the same style. Repeated transverse divisions and elongation of the suspensor cells push the embryonal cells first to the lower part of the style and finally into the basal ends of the embryo sacs where endosperm formation has already taken place.

As a rule only a single pro-embryo develops further and the embryonal tier divides repeatedly giving rise to a globular mass of cells. The two cotyledons are somewhat unequal and fuse along their inner margins. The radicular end shows a number of lateral processes. The cotyledons are situated in the middle of the endosperm but the hypo-cotyledonary region and the radicular end project above it. The ovoid fruit is a pseudoberry with a massive endosperm enclosing a single naked embryo.

The outer wall of the fruit develops the characteristic viscid layer which helps in dispersal.

The absence of the placenta and the ovules, the elongation of the embryo sac into the style and the formation of the long biseriate pro-embryo are unique features of the Loranthoideæ. The conical mamelon of *Amyema*[1] and *Helicanthes*[3] is devoid of any basal lobes but in *Macrosolen*,[1,2] *Lepeostegeres*[1] and *Elytranthe*,[1] there are three basal lobes completely free from the ovary wall. In *Lysiana* alone the mamelon is 4-lobed and the part in between the lobes is fused with the ovary wall. Therefore the condition in this genus may be regarded as more primitive than that in the other 5 genera.

I am greatly indebted to Prof. P. Maheshwari and Dr. B. M. Johri for guidance and criticisms, to Mrs. E. L. Robertson (Adelaide) for generously collecting and sending the material on which this investigation is based, and to the Government of Mysore for the award of a scholarship.

Dept. of Botany,                    R. Narayana.
University of Delhi, Delhi-8,
*October 12, 1953.*

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## THE EMBRYOLOGY AND SYSTEMATIC POSITION OF *TRAPA BISPINOSA* ROXB.

Gibelli and Ferrero[3] published an account of morphology, anatomy, fruit formation and germination of seed in *T. natans*; Ishikawa[5] studied megasporogenesis and embryo sac formation ; and Tison[7] described the development of the suspensor in the same species.

Bentham and Hooker[1] placed *Trapa* in the family Onagraceæ, Pulle[6] in Trapaceæ; and Engler and Prantl[2] in Hydrocaryaceæ. Hutchinson[4] includes it in the suborder Trapoideæ as an appendix to Onagraceæ. In view of these conflicting opinions it was considered worthwhile to investigate the Indian species, *T. bispinosa,* to find out how far embryological data confirm or reject the above assignment.

The wall of the microsporangium comprises the persistent epidermis, fibrous endothecium, 2-3 middle layers and the multinucleate glandular tapetum which is often 2-layered at certain places here and there. The inner wall of the tapetal cells shows some cutinization. The

microspore mother-cells undergo simultaneous reduction divisions and form decussate and tetrahedral tetrads. The mature pollen grains are pyramidal with 3 meridional crests and are shed at the 2-celled stage.

The pendulous ovule is anatropous, bitegmic and crassinucellate. The massive nucellar beak protrudes beyond the integuments (Fig. 1). A 1- or 2-celled archesporium differentiates in the young nucellus (Fig. 2). The megaspores are arranged in a linear fashion (Fig. 3) but occasionally ⊥-shaped or isobilateral tetrads are also formed. The chalazal megaspore functions and leads to the formation of 2- and 4-nuclate embryo sacs (Figs. 4-6).

The organised embryo sac is very slender.
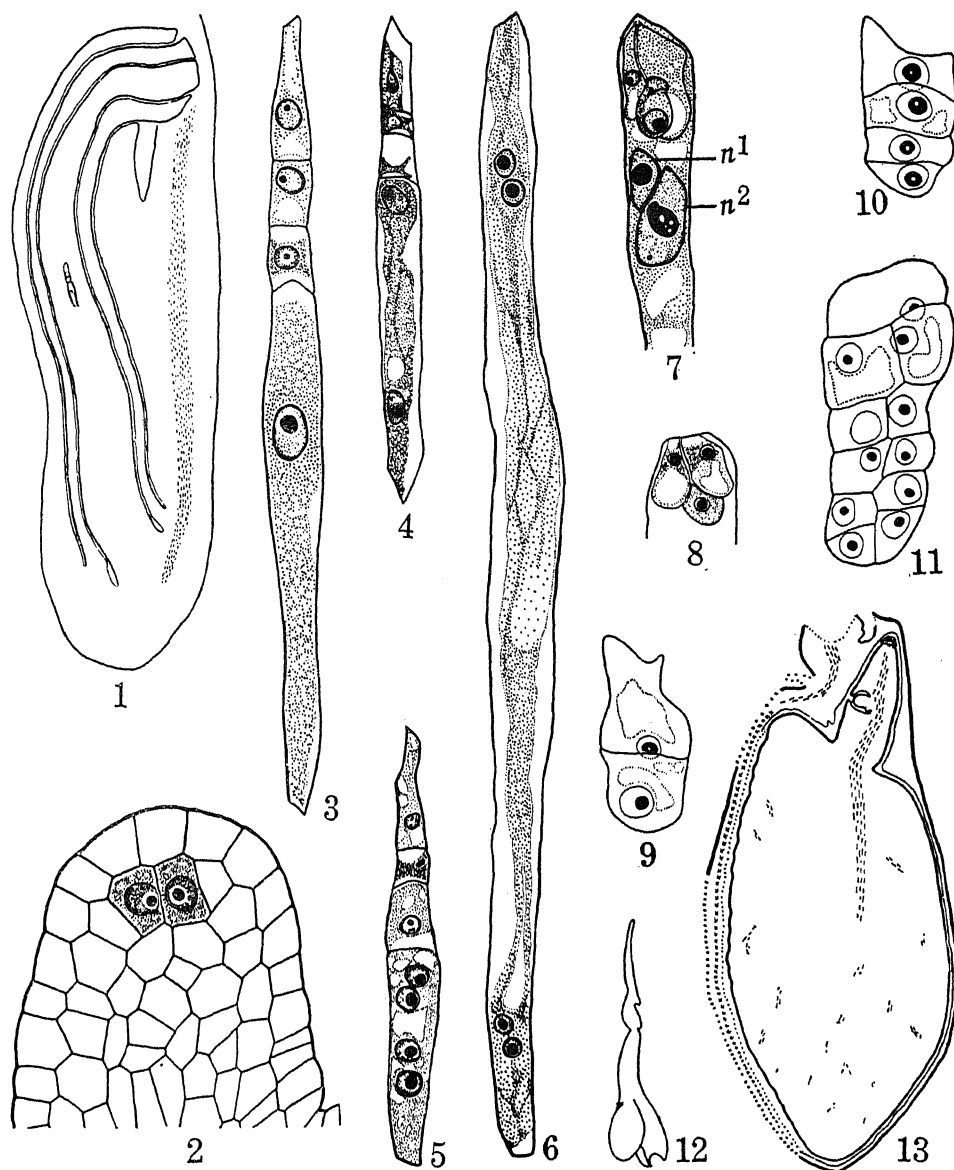


FIG. 1. L.s. ovule at tetrad stage, × 55.     FIG. 2. Hypodermal archesporial cells, × 612.     FIG. 3. Linear tetrad of megaspores, × 612.     FIGS. 4-6. 2- and 4-nucleate embryo sacs, × 355.     FIGS. 7-8. Upper ends of mature embryo sacs; for explanation of $n^1$ and $n^2$ see text, × 355.     FIGS. 9-11. Earlier stages of embryo development, × 504.     FIG. 12. Embryo with massive suspensor, × 14.     FIG. 13. L.s. mature seed showing one large and one very small cotyledon, × 6.

The micropylar end, which is broader and slightly curved, contains a normal egg apparatus (Fig. 8). Fig. 7 also shows two large nuclei of unequal size situated below the egg ($n^1$, $n^2$). They may represent the two polars. Or, the larger nucleus ($n^2$) may have arisen by the fusion of the antipodal nuclei and the smaller ($n^1$) by the fusion of the polar nuclei. Still another possibility is that the larger may be the fusion product of all the four nuclei at the chalazal end. No antipodals were observed.

Ishikawa[5] reports that in *T. natans* the antipodal nuclei may either degenerate or fuse to form a large hypertrophied nucleus. I invariably observed a hypertrophied nucleus at the basal end of the fertilized embryo sac but am unable to make a definite statement about its origin. None of the embryo sacs showed any trace of endosperm. Tison[7] also failed to find an endosperm in *T. natans*. It will require further work before giving a complete picture of the organization of the mature embryo sac and the presence or absence of endosperm.

The first division of the zygote is transverse (Fig. 9) and both the terminal and basal cells divide transversely (Fig. 10). After the 4-celled stage the basal cell remains undivided while transverse and longitudinal divisions of other cells result in a biseriate proembryo of 6 tiers (Fig. 11). Further divisions continue but are less regular. The suspensor cells elongate and push the embryo downwards, becoming much coiled as in many gymnosperms. Later, a suspensor collar, open on one side, envelops the embryo (Fig. 12).

The embryo has one large and massive cotyledon; the other, which arises very late, is extremely reduced and is seen as a small protuberance near the stem tip (Fig. 13).

*Trapa* has a bilocular, semi-inferior ovary with a single pendulous ovule in each chamber. The embryo sac is probably of the monosporic 8-nucleate type and an endosperm seems to be lacking. The embryo shows a characteristic coiled suspensor and one of the cotyledons becomes arrested. It bears little resemblance to the embryo of the Onagraceæ even in earlier stages of development. The fruit is a one-seeded drupe. Evidently it is incorrect to assign the genus to the family Onagraceæ where the ovary is usually tetralocular with many ovules in each chamber, the embryo sac is of the Oenothera type, the embryo conforms to the Onagrad type, the suspensor is poorly developed, both the cotyledons are similar and well developed, and the fruit is a loculicidal capsule.

The erection of a separate family Trapaceæ (Pulle[6]) or Hydrocaryaceæ (Engler and

Prantl[2]) is, therefore, fully justified on embryological grounds.

It gives me great pleasure to express my gratitude to Dr. B. M. Johri and Prof. P. Maheshwari who suggested the problem and guided the work.

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University of Delhi,
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## CORPUS ALLATUM IN *IPHITA LIMBATA* STAL.

A NOTE on corpus allatum of *Iphita limbata* Stal. was published by the author recently. With reference to the secretory product mentioned in the text, he has been able to obtain a photograph of the section of the corpus allatum of a nymph just about to moult into the imago,



FIG. 1. Photograph of section of corpus allatum from the nymph of *Iphita limbata* Stal., about to moult into the imago. Fixation in dichromate-formal-acetic; stain iron hæmatoxylin. The structure lying near the corpus allatum is the aorta.

where also the secretion is seen as a granular mass stainable blue by hæmatoxylin after

fixation in dichromate-formal-acetic. This is another evidence for the accumulation of secretion in the corpus allatum.

Zoology Laboratory,            K. K. NAYAR.
University College,
Trivandrum, Camp: London,
*October 19, 1953.*

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## ON THE VIVIPAROUS HABIT OF THE FRESH-WATER SNAKE, *ENHYDRIS DUSSUMIERI* (SMITH)

WHILE snakes are mostly oviparous, there are some known to be viviparous, especially members of the subfamily Homalopsinæ.[4] Adaptations to viviparity and development in these lower amniotes are of considerable scientific interest. Weekes[5,6] in two species of *Denisonia* and Kasturirangan[1,2] in two sea-snakes, have described the structure and formation of the placenta in those forms. The author has previously described the placentation in the brackishwater snake—*Cerberus rhynchops.*[7]
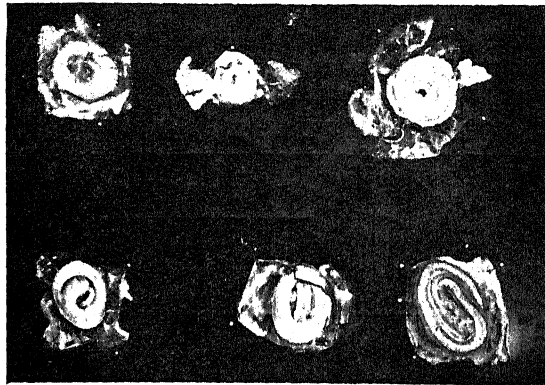


(*i*) *Enhydris dussumieri*—embryos in stages of development.

*Enhydris dussumieri* is a viviparous fresh-water snake commonly found in North Travancore and locally known by various names in Malayalam as *Thadikkipotten, Polavan,* etc. The snake is quite harmless, sluggish in habits and easily survives in captivity. A detailed study on the development and adaptations to viviparity in this snake is being carried out.

Observations show that the snake breeds early in June with the onset of the south-west monsoon, the period of gestation lasting more than 5 months. Early eggs in the uterus are elliptical in shape and, as usual in reptiles, megalecithal, measuring 20 mm. × 15 mm. The

blastodisc lies over a small area of the yolk mass. There is no egg shell as such, but a very thin shell membrane is present. The number of eggs was found to vary in different specimens. A large number of eggs, however, begin development in the two uteri, and probably
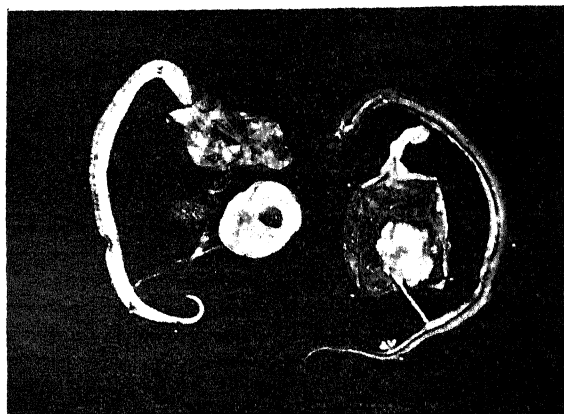


(*ii*) Embryos of two later stages displayed showing body stalk, yolk sac and allantois.

during their development some atrophy, and the number is reduced towards the final stages of pregnancy, the yolk in the atrophied eggs being absorbed by the developing embryos. The snake is all the same prolific, and in one instance 25 living embryos (Figs. 1–3) were given by birth by a female.
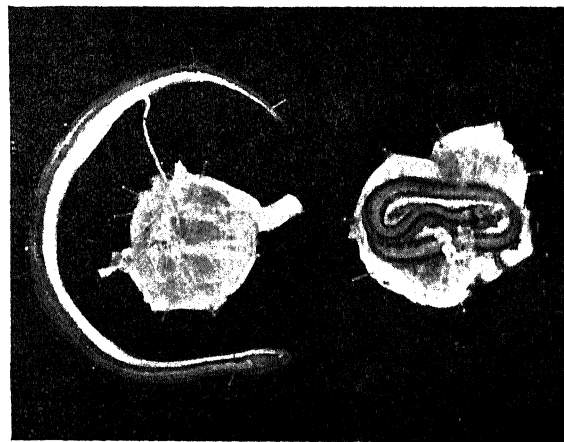


FIG. 3. 'Advanced embryo of length 9 inches with the egg yolk fully absorbed and placental features completely established.'

The egg yolk is fully consumed when the embryo measures about 7″ in length and this roughly indicates 4 months gestation. By now

the highly vascular allantois has grown round the embryo and a chorio-allantoic placenta is fully established. This species of snake is thus truly viviparous. Gestation is further continued for a month, the full grown embryo reaching a length of 9″. At birth, the allantois with its umbilical vessels is discarded.

Further work is in progress.

Dept. of Zoology,      K. N. PARAMESWARAN.
Sanatana Dharma College,
Alleppey, *November* 12, 1953.

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## ON NEOTEINIC TERMITES FROM A COLONY OF *MICROCEROTERMES BEESONI* SNYDER (ISOPTERA, TERMITIDAE)

NEOTEINIC termites have been reported only once in India from Bombay from a colony of *Microcerotermes Heimi* Wasm.[1] There were 13 queens (apterous or brachypterous unknown) and no males. A small carton nest of *M. beesoni* Snyder was recovered fom Delhi recently from the soil round the base of the stem of a pear tree. This contained largely the workers, nymphs, a few soldiers and in addition 45 brachypterous neoteinic females, but no males. The adult macropterous caste was also unrepresented. The neoteinic forms were distributed in nearly 20 chambers most of which also contained egg-masses. These forms were obviously reproducing as was proved by the fact that they laid eggs even when kept singly in glass tubes. Absence of any male with them suggests the occurrence of parthenogenesis, a view previously expressed in respect of some termites.[2,3]

All brachypterous forms were morphologically alike except for slight differences in the size of abdomen in some owing to physogastry. Each possessed two pairs of short wing-pads arising from the meso- and metanotum and extending up to the second and third abdominal tergite (Fig. 1). Both pairs were equal and similar in all specimens, being 0·94 mm. in

majority, smallest being 0·73 mm. in one specimen and longest 1·6 mm. in two specimens. The brachypterous forms closely resemble the imago[4] in most external characters, *e.g.*, eyes,
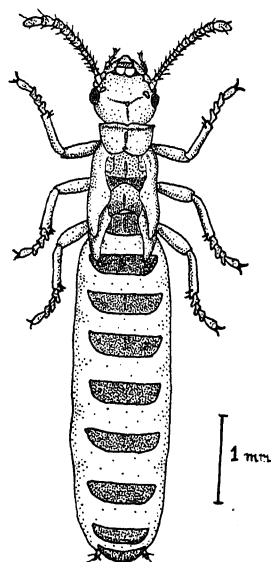


ocelli, fontanelle and pronotum but differ in having (*i*) a smaller body (Table I), and (*ii*) 13 segments in antennæ instead of 14.

TABLE I

| | Brachypterous form | | Winged adult (measurements after Snyder in mm.) |
| --- | --- | --- | --- |
| | Range (in mm.) | Majority (in mm.) | |
| Length of body (Non-physogastric) | 3·94–4·34 | 4·00 | 5·0 –6·0 |
| Length of head | ·95–1·03 | 1·03 | 1·05–1·1 |
| Width of head | ·73– ·78 | ·75 | 0·8 0·85 |
| Length of pronotum | ·35– ·39 | ·37 | 0·4 |
| Width of pronotum | ·60– ·66 | ·62 | 0·65 0·7 |
| Length of hind tibia | ·64– ·68 | ·68 | 0·8 |

Two individuals were recovered from the colony which seemed to be the nymphs of the brachypterous forms. They were both smaller in size and differed from the latter in some features: less pigmented cuticle, poorly developed compound eyes, ocelli absent, anterior margin of the pronotum much more elevated. One of them, slightly larger than the other, had developed two pairs of short wing rudiments as postero-lateral buds from meso- and metanotum while the other was still apterous. They were both males externally though gonads were not formed.

Besides these, the nymphs mainly consisted of those which had developed two pairs of longer wing-pads. In body measurements they were much larger than the brachypterous forms, and were rather nearer to the imago form. Their origin is presumed to be due to a possibly died out macropterous caste functioning previously.

It is concluded that this small colony was headed entirely by the brachypterous neoteinic forms, at least at the time of the collection, and then, in all probability, were reproducing parthenogenetically.

My thanks are due to Dr. M. L. Roonwal for kindly identifying this termite, and to Dr. M. L. Bhatia for his kind guidance in the work.

Dept. of Zoology,                H. S. VISHNOI.
University of Delhi, Delhi-8,
October 24, 1953.

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## 'GALLS' ON *SACCHARUM SPONTANEUM* L.

THE occurrence of 'galls' is a common feature in grasses and are known to be caused by gall midges (Cecidomyiid flies). Typical 'gall' formations have been noticed in the grass *Cynodon dactylon* (*Hariali*)[1] causing a malformation of the shape of a miniature pineapple. 'Galls' occurring on the stem, node and internode as also terminally due to the injury of the growing point have been reported as a fairly common feature in commercial sugarcane varieties in Hawaii and Java.[2]

During the course of the exploration work in connection with the collection of forms of *S. spontaneum,* the Botanist of this Institute collected specimens ('galls') from one of the *S. spontaneum* forms from Nainital District in Uttar Pradesh and another from Assam. Malformations or monstrous growths resembling 'galls' were noticed. These 'galls' were in the form of 'bunchy tops' (Plate) and on examination, it was found that the growing point was damaged and the several axillary buds at the condensed portion of the stalk proliferate. Very often the axillary buds were noticed to divide giving rise to 2 or 3 axillary shoots at each node. The laminæ and the leaf-sheaths cease to elongate and the sheaths grow in width, with the result that the axillary shoots often outgrow the leaves. The composite leaf spindle thus assumes a characteristic lanceolate shape, the widened sheaths and the growing buds together forming the 'bunchy top'.

On cutting open these 'bunchy tops', it was seen that the growing point was damaged and
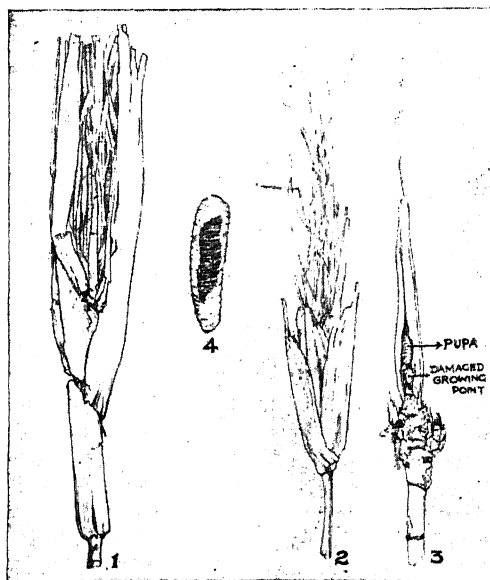


*Galls from Saccharum spontaneum*

1 and 2. Galls—As collected from nature.  3. A Gall dissected to show the damaged growing point, with pupa *in situ.*  4. A pupa.

in most cases immediately above it was found a 'Dipteran' pupa. This is evidently the causal agent. The search for larvæ and adults from the collected specimens, however, proved futile. In the absence of these stages of the insect, it was not possible to determine the genus. But Dr. Sabrosky has now given his opinion that the pupæ "probably belong to a new genus near *Anthrocophaga*; *Siphlus*; *Homalura*" in the family *Chloropidæ* (Diptera).

This is presumably the first record of any *Saccharum* species being attacked by this insect. The appearance of such insect 'galls' in the genus *Saccharum* has also probably been noticed for the first time. Attempts are being made to collect the adults with a view to studying its life-history as also to record the full description and to determine the genus and species.

My thanks are due to Shri R. R. Panje for kindly collecting these specimens for me and to Shri N. L. Dutt for kind encouragement.

Sugarcane Breeding Inst.,   G. NARASIMHA RAO.
Post Lawley Road,
Coimbatore, *November* 4, 1953.

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# REVIEWS

The Comets and Their Origin. By R. A. Lyttleton. (Cambridge University Press), 1953. Pp. x + 173. Price 25 sh. net.

Comets have been much talked of, particularly, by non-astronomers, but much is yet to be known about them. The word 'comet' signifies a long-haired star. All comets do not present the same standard features in their appearance nor does any one comet maintain the same appearance for long. A famous comet, named after Halley, has shown a bright nucleus wrapped up in a hazy patch called the coma and a tail of variable length. It has played a great part in the history of the Newtonian theory of gravitation. Another comet, famous in astronomical history, but which exists no more is Biela's comet that broke up into two in 1846.

In the book under review the first chapter is devoted to the dynamical features of comets, with periods from anything like 3 years to 40,000 years and with a very wide range of inclinations and eccentricities. In the second chapter the various baffling features of their physical properties are vividly described with diagrams and photographs, with a reference to their small masses, the large and variable sizes, the spectrum, the tails and the meteor showers. The next two chapters contain the author's original contributions to the subject of the origin and formation of comets and the formation of tails. In the last chapter convincing arguments are given showing how the earlier theories of Proctor, Chamberlin, Crommelin and others failed to account for the known facts regarding the comets. The accretion hypothesis which has been successfully used in the theory of stellar evolution offers, according to Lyttleton, an explanation of many of the strange properties of the comets. The latter are formed in the wake of the sun as it slowly moves in an interstellar cloud. Thus a comet "consists of very large numbers of widely separated particles". The author shows how internal collisions may produce lighter particles ultimately responsible for the tails. It is an attractive theory and an impressive volume of evidence is given in its support. If the theory is on sound lines it should be possible to construct more convincing mathematical proofs in the light of its main arguments. The book will be read with great interest by all those who are interested in comets and in the various challenging problems about them.        V. V. NARLIKAR.

Kernel Functions and Elliptic Differential Equations in Mathematical Physics. By S. Bergmann and M. Schiffer. (Academic Press, N.Y.), 1953. Pp. xiv + 432. Price 64 sh. net.

Today, applied mathematics is being recognized as a science in its own right and not as a mere watered down version of pure mathematics. The tendency has therefore been to foster the discipline of mechanics as a deductive mathematical science in the true classical tradition. It is to this end that the work of Bergmann and Schiffer on elliptic differential equations is devoted.

The theory of boundary value problems in partial differential equations occupies a central place in every branch of applied mathematics and theoretical physics. Treatises have been written on this subject by many authors, with varying degrees of emphasis on physical applications, but Bergmann and Schiffer have in addition attempted to 'rationalise' the theory of elliptic differential equations from a 'unifying point of view'.

The book comprises two parts, the first consisting of a survey, in four chapters, of boundary value problems from important branches of mathematical physics, heat conduction, fluid dynamics, electro- and magneto-statistics and elasticity. The chapter on fluid dynamics deserves special mention, for it summarises with clarity and precision many of the advanced ideas of fluid dynamics which are normally to be found only in treatises devoted solely to hydrodynamics. The authors show first with the aid of physical examples that all solutions of the elliptic differential equations occurring in physics can be expressed in terms of certain fundamental solutions or 'Kernel functions' whose main properties are: they depend on two argument points in the domain, they are symmetric in both and are functions of each separately. Examples of such solutions are the Green's, Neumann's and Robin's—G, N and R—functions. Though G, N and R functions possess singular points in the domain of definition, combinations of them can be found which are regular throughout the whole domain. Part II deals in a systematic manner with the properties of these fundamental solutions.

One general remark which may be made about the book is that it assumes a degree of familiarity with the methods of mathematical analysis not easily found in students of applied mathematics. However, to meet the needs of

such readers, the authors have nourished their rigorous analysis with physical applications in the first part of their book.

Two features of the book are to be specially noted: (1) the notation used in the first four chapters dealing with different branches of physics is consistent and emphasises the essential unity of the mathematical methods developed, (2) reference to books and original papers are given at the end of each section in addition to the comprehensive bibliography at the end of the book.

There is no doubt that the book will stimulate the interest of pure mathematicians in physical applications and create in the physicist a 'taste' for mathematical rigour.

ALLADI RAMAKRISHNAN.

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**Electrodeposition Research.** (*NBC Circular* 529, issued May 22, 1953.) (Available from Supdt. of Documents, U.S. Govt. Printing Office, Washington 25, D.C.) Price $ 1.50.

The publication is a collection of twenty-two papers presented at the Symposium on Electrodeposition Research held by the National Bureau of Standards organized during the Bureau Semi-Centennial in 1951.

G. E. Gardam in his paper, 'Research on Electrodeposition in Great Britain', dwells on the distribution of research effort among the various institutions, producers of plant and material and consumers, and indicates a few typical recent research projects investigated. These studies relate to fundamental causes of porosity of nickel-coating of steel, production of thick nickel deposits, adhesion of electrodeposits of aluminium, electrodepolishing, and alloy deposition of tin and nickel. 'Electroplating in France' by Jean Salauze indicates the important lines of research relating to the development of chromium plating and study of nature of chromium deposits and fundamental investigations relating to electropolishing and anodising of aluminium. 'Electroplating Research in Germany, Belgium and Holland' by Baeyens reveals that the subjects of study in Germany are mainly hard chromium plating, anodising, bright nickel plating and electrolytic polishing. In Belgium and Holland, recent objects of study have been conversion coating on zinc and cadmium and the metallising of non-conductors. Development and utilisation of electroless nickel-plating is another investigation of interest. Several papers are devoted to research carried on in different research organisations in U.S.A. such as the National Bureau of Standards, Battele Memorial Institute, Bureau of Mines and the Armour Research

Foundation. Progress of research in laboratories of some important industries like the Westinghouse Electric Corporation, United Chromium Inc., Enthone Inc., Sylvania Electric Products, have been presented in a few papers. There are some outstanding individual contributions on different subjects of interest to the electroplater, *viz.*, studies in corrosion resistance of electrodeposits, effects of impurities and their determination in plating solutions, physical properties of electrodeposited nickel, porosity of electrodeposits and disposal of cyanide wastes. It is observed from the deliberations that subjects like chromium plating, electropolishing of metals and alloys, periodic reverse current plating, plating on aluminium and titanium and alloy deposition are receiving considerable attention in the various research centres.

The publication is a valuable contribution facilitating easy correlation of information and results of research.

J. BALACHANDRA.

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**Chemistry of Carbon Compounds. Vol. II. Part A.** *Alicyclic Compounds.* Edited by E. H. Rodd. (Elsevier Publishing Co., Amsterdam), 1952. Pp. xx + 488. Price 75 *sh.*

The object of this 5-volume treatise is 'to fill the need for an up-to-date systematic book intermediate in size between the great Encyclopædias such as Elsevier and Beilstein and the shorter and mainly instructional works such as Karrer and Fieser. It may be regarded as a successor to Richter's "Organic Chemistry". Nine of the eleven chapters in the present volume, very ably written by a single author, Dr. R. A. Raphael, comprise a general introduction to alicyclic compounds; cyclopropane, cyclobutane, cyclopentane, cyclohexane, cycloheptane, cyclo-octane and macrocyclic groups; polynuclear alicyclic compounds with separate ring systems, spiro compounds and condensed cyclic systems; and bridged ring systems. Brief accounts (by Dr. L. Crombie) of pyrethrins, cinerins and jasmone, and of hydnocarpic, chaulmoogric, gorlic and related acids are included in Chapter IV (cyclopentane group). Chaulmoogra oil is mentioned as an ancient remedy for tuberculosis and leprosy without an indication that its use in leprosy is well established, while it has no therapeutic value in tuberculosis. A reference is made to the work of R. Adams on the preparation of analogues of chaulmoogric and hydnocarpic acids as possible leprocides, but not to his observations regarding relationships between *in vitro* leprocidal activity, chemical constitution and surface activity. Among the properties of dihydroresorcinol and

dimedone an omission is their ability to couple with diazonium salts; the use of such azo dyes for cellulose acetate has been suggested.

Dr. R. F. Hunter has a very lucid and readable chapter on the carotenoid group.

Chapter XI by Dr. R. G. R. Bacon deals with open-chain and cyclic polymers derived from olefinic compounds: rubber and rubber-like compounds, natural and synthetic, and their derivatives. Evidence in favour of the presence of 1 : 2'-linkages in polyindenes has not been mentioned.

A few typographical errors (*e.g.*, "an" for "as" in p. 426, line 41; "cmulsion" in line 38 and "a : 1 mixtures" in line 39, p. 428) have been noticed.

In contrast with Vol. I, and inevitably so because of the difference in the contents of the two volumes, parts of Vol. II are not easy to read and it will be valued primarily as a comprehensive and dependable book of reference.

K. V.

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Plant Life in the Scottish Highlands. (*Ecology and Adaptation to Their Insect Visitors.*) By Alexander Edward Holden, with photographs by Robert M. Adam. (Oliver & Boyd), 1952. Pp. xv + 319. Price 30 *sh.* net.

This book, though of value to the general botanist, is intended for hill-walkers and visitors to the Scottish Highlands who do not want a complicated text-book on the hill plants, but would like to know the names of the plants they come across during their wanderings on the hills. It is intended to help them to identify the plants and also to give them a short account of the life-history of the plants, their adaptation to surroundings and their insect visitors. The book is illustrated by numerous excellent photographs by Mr. Robert M. Adam, which will enable the reader to get a clear idea of the plants and will easily enable them to identify them.

The book gives the reader an excellent idea of the great untamed wilderness of mountains, moorland and bog known as the Scottish Highlands. The author has portrayed the beauties of this lovely country, with special reference to its flowering plants and the conditions which influence their growth. The flora is akin to that of Scandinavia, but many species found there are peculiar to the region, and many are highly interesting from a scientific, as well as from an æsthetic point of view.

The author describes the flora in easy language so that the ordinary reader will have little difficulty in recognizing the commoner species. He gives an account of each plant in relation to its environment and also the conditions of life it has to face, with special reference to its adaptations to combat these conditions. He describes in a graphic manner the beautiful places these plants inhabit, with descriptions of some of the loveliest spots in the Highlands. He also describes how their flowers are amazingly constructed with regard to their insect visitors and fertilization.

The book is most delightfully written and makes fascinating reading.

The book will also serve as an excellent introduction to plant ecology and will be found very useful both to the ordinary reader and the general botanist alike. The book ought to find a place not only in the library of every plant lover but also in the libraries of the botany departments of all colleges.

M. O. P. Iyengar.

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Immunochemistry. (*Biochemical Society Symposia No. 10.*) Eidted by R. T. Williams. (Cambridge University Press), 1953. Pp. 94. Price 12 *sh.* 6 *d.* nett.

The book is a compilation of seven important papers communicated to the Biochemical Society's Symposium on Immunochemistry held at the London School of Tropical Medicine on 15th November 1952, and carries a short introduction by J. R. Marrack. A fairly full survey with valuable references is presented on each subject by specialists actively engaged in research in the respective fields in a clear and excellent form and is therefore of great value to both students and investigators who are concerned with the different problems in immunochemistry.

The first three communications deal mainly with investigations on the nature and mechanism of antigen-anti-body reactions studied in relation to protein structure by J. R. Marrack in the first paper, to systems involving enzymes as antigens by B. Cinader in the second paper and to systems involving bacterial toxins and anti-toxins by W. E. Van Heyningen in the third paper.

The next paper by G. E. Francis on "The Use of Isotopes in Immunology" brings out fully the important use of isotopic tracer techniques in studies on antigen-anti-body reactions and those on the formation, structure and *in vivo* action of anti-bodies.

The paper by P. G. H. Gell embodies studies on the role of antigens and anti-bodies on the two important and well accepted states of hypersensitivity, namely, the asthma-œdema-

anaphylaxis type and the tuberculin-dermatitis type.

In the sixth paper by M. Stacey 'On the Role of Carbohydrates in Immunochemistry', the outstanding work of Heidelberger and his associates on pneumococcal capsular type specific polysaccharides and the studies on the complex polysaccharides of mycobacterium tuberculosis by the author and his colleagues have been mainly reviewed and discused.

The final paper by R. G. S. Johns presents a review and discussion of the studies on the relation of complement to the nitrogen bound by antigen antibody precipitates.

As a whole, the monograph is exceedingly well executed.

P. SESHAGIRI RAO.

## Books Received

*The Indus Civilization.* By Mortimer Wheeler. (Cambridge University Press), 1953. Pp. xi + 98. Price 18 *sh.* net.

*Thermionic Valves, Their Theory and Design.* By A. H. W. Beck. (Cambridge University Press), 1953. Pp. xvi + 570. Price 60 *sh.* net.

*Corrugated Concrete Shell Roofs.—Bullet. Cent. Build. Res. Inst.,* Vol. I, No. 3. (C.S.I.R.), 1953. Pp. 38. Price Rs. 1-8-0.

*Advances in Virus Research.* Edited by Kenneth M. Smith and Max A. Lauffer. (Academic Press, Inc.), 1953. Pp. vii + 362. Price $ 8.00.

*Mechanical Vibration.* By G. W. Van Santen. (Philips' Technical Library), 1953. Pp. xvi + 296. Price not known.

*Statistical Methods in Electrical Engineering.* By D. A. Bell. (Chapman & Hall), 1953. Pp. viii + 175. Price 25 *sh.* net.

*The Chemistry of Heterocyclic Compounds— Imidazole and Its Derivatives.* By Klaus Hofmann. (Interscience Publishers), 1953. Pp. xviii + 447. Price $ 13.50.

*Relays for Electronic and Industrial Control.* By R. C. Walker. (Chapman & Hall), 1953. Pp. xi + 303. Price 42 *sh.* net.

*International Review of Cytology,* Vol. II. Edited by G. H. Bourne, J. F. Danielli. (Academic Press, Inc.), 1953, Pp. vii + 545. Price $ 11.00.

*Data and Circuits of Television Receiver Valves.* By J. Jager. (Philips' Technical Library), 1953. Pp. xi + 216. Price Rs. 10.

*Fluorescence of Solutions.* By E. J. Bowen and Frank Wokes. (Longmans, Green & Co.), 1953. Pp. vii + 91. Price Rs. 25.

*An Introduction to Electronics for Physiological Workers.* By I. C. Whitefield. (Macmillan & Co.), 1953. Pp. ix + 236. Price 18 *sh.*

*Scientific Papers Presented to Max Born.* (Oliver & Boyd), 1953. Pp. vi + 94. Price 12 *sh.* 6 *d.* net.

*An Introduction to the Theory of Seismology.* By K. E. Bullem. (Cambridge University Press, Inc.), 1953. Pp. xv + 296. Price 35 *sh.*

*Selected Topics from Organic Chemistry,* Third Edition. By D. D. Karve and G. D. Advani. (Dastane Brothers' Home Service, Ltd., Raviwarpet, Poona 2). Pp. vi + 507. Price Rs. 12.

*A Class Book of Physics,* Fourth Edition. By Gregory and Hadley (Macmillan & Co.), 1953. Pp. xiii + 656. Price 12 *sh.* 6 *d.*

*Tables of Barometric Pressures at Varying Temperatures.* By J. D. W. Ball. (Constable & Co.), 1953. Pp. 23. Price 5 *sh.*

*Tables of Natural Logrithms for Arguments Between Zero and Five to Sixteen Decimal Places.* (NBS Applied Mathematics Series 31, U. S. Dept. of Commerce), 1953. Pp. x + 501. Price $ 3.25.

*Simultaneous Linear Equations and the Determination of Eigen Values.* Edited by L. J. Paige and Olga Tanssky. (NBS Applied Mathematics Series 29, U.S. Dept of Commerce), 1953. Pp. iv + 126. Price $ 1.50.

*An Introduction to the Theory of Seismology.* Second Edition. By K. E. Bullen. (Cambridge University Press), 1953. Pp. xv + 296. Price 35 *sh.* net.

*Animal Nutrition Research in India.* By K. C. Sen. (Macmillan & Co., Calcutta-12), 1953. Pp. xii + 370. Price Rs. 15.

*Medicine in Oxford, A Historical Romance.* By Maurice Davidson. (Macmillan & Co.), 1953. Pp. 70. Price 10 *sh.* 6 *d.* net.

*Experimental Inorganic Chemistry.* By R. E. Dodd and P. L. Robinson. (Elsevier Publishing Co.), 1954. Pp. xii + 424. Price 42 *sh.*

# SCIENCE NOTES AND NEWS

## Lady Tata Scientific Research Scholarships, 1954-55

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1954-55 commencing from 1st July 1954. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognized University. The scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of a scientist of standing in a recognized research institute or laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trust. Candidates can obtain these instructions and other information they desire from the Secretary, The Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

## Symposium on Wind Power and Solar Energy

India has accepted the invitation of the Director-General of UNESCO to act as the host country for the symposium to be held in October 1954, under the auspices and as part of the activities of the UNESCO Advisory Committee on Arid Zone Research. The National Institute of Sciences will organize the symposium on behalf of the Government of India, jointly with UNESCO.

## Synthesis of Sucrose

The chemical synthesis of sucrose was among the major advances reported at the American Chemical Society's 124th National Meeting, held in Chicago during September 6-11, 1953. Raymond U. Lemieux, and George Huber of the Prairie Regional Laboratory of the Canadian National Research Council at Saskatoon tackled the project last April despite overwhelming evidence that it could not be done. By June they succeeded in making sucrose out of derivatives of glucose and fructose, which had been made synthetically by previous investigators. Lemieux and Huber also synthesized maltose and a less common sugar, trehalose, in the course of their experiments.

Since natural sucrose is both abundant and cheap, the synthetic product is unlikely to find commercial application, but the Lemieux-Huber achievement represents a significant contribution to carbohydrate chemistry which promises to make the synthesis of many complicated substances a matter of easy routine.

## Ductile Iron

The development of a variety of cast iron which can twist, bend and bounce on impact instead of breaking has been announced in a recent issue of the *Journal of the Franklin Institute* (1953, 255, 342). Basically, ductile iron is made by adding a small amount of magnesium and nickel to iron. In engineering properties it bridges the gap between cast iron and steel. It is wear and heat-resistant and has numerous applications in almost every branch of industry.

## Exemption of Customs Duty on Research Material

The Government of India have decided to consider, on an *ad hoc* basis, requests for the grant of exemption from customs duty leviable on research materials, such as sera, vaccines, drugs, etc., supplied free of cost to approved Government research institutions for research purposes. Applications for the grant of exemption from duty may be made to the Ministry of Finance (Revenue Division) through the Collector of Customs or the Collector of Central Excise concerned.

## X-Ray Therapy

A 15-million volt linear accelerator, stated to be the most powerful apparatus of its kind in existence for medical purposes, is to be installed at St. Bartholomew's Hospital, London, for X-ray therapy.

The accelerator produces penetrating rays by the bombardment of platinum foil with electrons of a potential of 15 million volts : by comparison, the cobalt bomb, another recent device for therapy, produces X-rays of 1,300,000 volts. The great penetration of the X-rays makes it a powerful means of treating tumours situated deep in the body, at the same time reducing the damage to skin and other superficial tissue.

In addition to the high energy, the output of X-rays from the accelerator will be about 50 times greater than that from ordinary X-ray

machines or the cobalt bomb. It will be used for the treatment of cancer, the development of new methods of treatment and fundamental research on the effects of high energy on the body.

## Study of Poliomyelitis

A worldwide programme of research on poliomyelitis has been recommended to the World Health Organization by an Expert Committee which met recently in Rome. It is proposed that designated research laboratories in all continents should function as WHO Regional Laboratories and that they undertake various studies, particularly in identifying and examining various strains of the poliomyelitis virus. While the incidence of a number of epidemic diseases has been sharply reduced, the Expert Committee observed that poliomyelitis is likely to present an increasingly serious problem in almost all countries of the world. Proposals of the Committee are to be considered by the WHO Executive Board shortly.

## Artificial Hibernation in Heart Surgery

One of the difficulties about surgical operations upon the heart and in certain other circumstances is that it may be necessary to stop the circulation of the blood for a period of time. Certain vital centres, for example in the brain, may be seriously affected by this, but it has been found that if the demands of the body cells for oxygen could be diminished, then a relatively longer period of reducing or cutting off the blood supply would be possible with safety.

Out of this idea has come the present method of reducing body temperature, a sort of 'artificial hibernation' so as to diminish the chemical activity of body cells. Three reports in a recent issue of the *British Medical Journal* are concerned with this new problem. Various ways of lowering body temperature have been devised and, in fact, the method is already in use in certain centres for heart surgery in Great Britain and abroad.

## National Institute of Sciences of India

Officers for 1954 : *President* : Dr. K. S. Krishnan (Delhi); *Vice-Presidents* : Prof. S. K. Banerji (Calcutta); and Dr. B. Mukerji (Lucknow); *Treasurer* : Prof. D. S. Kothari (Delhi); *Foreign Secretary* : Prof. P. C. Mahalanobis (Calcutta); *Secretaries* : Prof. R. C. Majumdar (Delhi); and Dr. B. P. Pal (Delhi); *Editor of Publications* : Prof. J. M. Sen (Calcutta).

*Ordinary Fellows* : Dr. B. C. Basu (Izatnagar), Dr. S. K. Bhattacharya (Kharagpur), Dr. K. Chandrasekharan (Bombay), Prof. K. R. Dixit (Bombay), Dr. S. Ghosh (Allahabad), Dr. A. G. Jhingran (Calcutta), Prof. S. Kilpady (Nagpur), Dr. Z. R. Kothavala (Bangalore), Dr. L. S. S. Kumar (Poona), Mr. N. V. Modak (Bombay), Dr. C. Radhakrishna Rao (Calcutta), Mr. A. K. Roy (New Delhi), Dr. R. N. Sen (Calcutta), Principal M. R. Sen Gupta (Banaras), Dr. S. M. Sircar (Calcutta), *Honorary Fellows* : Prof. Sydney Chapman (Oxford), Prof. V. A. Engelhardt (Moscow), Prof. W. Heisenberg (Gottingen, West Germany), Prof. Paul Karrer (Switzerland).

## Indian Botanical Society

The following authorities of the Indian Botanical Society have been constituted for the year 1954 as the result of election announced at the 33rd Annual General Meeting of the Society held at Hyderabad.

*President* : Dr. R. K. Saksena, Allahabad ; *Vice-Presidents* : Dr. K. A. Chowdhury, Dehra Dun; and Dr. Y. Bharadwaja, Banaras; *Hony. Secretary* : Dr. R. Misra, Sagar; *Treasurer and Business Manager* : Dr. T. S. Sadasivan, Madras; *Editor-in-Chief* : Dr. A. C. Joshi, Chandigarh,

## Award of Research Degree

On the basis of the report of a Board of Examiners, the Banaras Hindu University has awarded the Ph.D. Degree in Biochemistry to Sri. Brij Mohan Lal for his thesis entitled "Studies in Supplementary Food".

The Bombay University has awarded the Ph.D. Degree in Chemistry to Shri Dhirajlal N. Shah for his thesis entitled "Studies in Fries Migration".

## SIR SHANTI SWARUPA BHATNAGAR

SIR S. S. BHATNAGAR, Director, Scientific and Industrial Research, Government of India, whose sixtieth birthday on February 21 was celebrated by scientific and learned societies all over the country, occupies indeed a unique position in the field of Indian science. As Prime Minister Nehru observed on a recent occasion, the gigantic programme of building the National Laboratories would never have gone as far ahead as it has but for the drive and enthusiasm of Bhatnagar. It may be said that he has been in no small measure responsible for the status to which science in India has attained in recent years.

The record of his career both as a scientific investigator and later as organiser of large-scale scientific research is rather enviable. In 1919, he went to England and worked under Prof. F. G. Donnan. He also worked at the Sorbonne, Paris and the Kaiser Wilheem Institute, Berlin, for sometime. He returned to India as Professor of Chemistry at Banares Hindu University where in a short time he created an active school of physical chemistry. In 1924,

Bhatnagar was invited to join the Punjab University as University Professor of Physical Chemistry and Director, University Chemical Laboratories at Lahore. His sixteen years' stay there was characterised by intensive activities in the domain of research. In 1926, he switched over to magneto-chemistry, a field in which he and his pupils may be considered as pioneers. In collaboration with R. N. Mathur, he devised a magnetic interference balance which was manufactured by Adam Hilgers.

His scientific work has won him many honours. In 1943, the Society of Chemical Industry elected him an Honorary Fellow and later as Vice-President. The same year, he was elected a Fellow of the Royal Society. He is a past President of Indian Science Congress and the National Institute of Sciences of India.

It was only in the fitness of things that Bhatnagar was invited to function as Director of Scientific and Industrial Research when the war broke out. In spite of heavy administrative and advisory duties, Bhatnagar found time to take a personal interest in research work and

several processes of great importance were worked out by him and his staff. Included amongst these are anti-gas cloth and varnish, air-foam solution, vegetable oil blends as lubricants and fuels, unburstable containers, glass substitutes, dehydrated castor oil, plastics from Indian wastes and others.

Originally a war-time assignment, the activities of the organisation which he then set up have since been geared to the harnessing of science to the promotion of national welfare. The Government of India has now a Ministry of Natural Resources and Scientific Research, of which he is the Secretary. Amongst the new developments which have been initiated at his instance, in addition to the well-known instances of the National Laboratories, are the establishment of Indian Rare Earths Limited, to process monazite sands, intensification of the search for atomic minerals and sulphur-bearing ores.

The National Laboratories which may with every justice be regarded as the handy work of Bhatnagar represent a symbol of the kind of progress to be expected in a country which has already made valuable contributions in several branches of science. They can vie with the best of their compeers in any part of the world.

Bhatnagar has devoted considerable attention to the practical utilisation of the results of scientific research, which have culminated in the establishment of a National Research Development Corporation.

Amongst other achievements, the following owe their initiation more or less to Bhatnagar's imagination and drive : the scheme of foreign scholarships for higher studies in technical subjects, exemption for expenditure on research from income-tax, Indian Standards Institution, Regional Polytechnics, to mention only a few.

A born administrator, he is always in close touch with every branch of activity under his care. Quick decisions and a tacit faith in his lieutenants are characteristics which have contributed considerably to the successful discharge by him of any assignment. The establishment of oil refineries in India is in a great measure the result of his pursuasive influence and skill as a negotiator.

As Sir Robert Robinson has observed, it is indeed fortunate that India found at a critical time in her history an eminent scientist of clear vision, sound judgement in affairs and boundless energy in action. His high office has enabled him to realise wisely ambitious plans and today are to be seen the concrete results, a dream come true and one which lies especially closest to his heart.

Our heartiest felicitations to Sir S. S. Bhatnagar on this memorable occasion.

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## USE OF ATOMIC ENERGY FOR PEACEFUL PURPOSES

THE peaceful uses of atomic energy in developing electric power and the uses of atomic rays in medicine, agriculture and industry, are the subject of a 16-page feature in the December issue of the *UNESCO Courier*. The possibilities for the future development of countries that lack coal, for the use of atomic rays in the treatment of disease and of artificial radioactive materials in the improvement of food production, the maintenance of health and the efficiency of industry are so great that they are fully discussed in a series of articles intended primarily for the school teachers of the world and through them to the school children of the world.

The *Courier* gives a complete but simple story of the ABC of nuclear physics and includes the story of the natural rays from such materials as radium, cosmic rays, the uses of the great cyclotron and the many scientific discoveries that have come from the use of artificial radioactive materials. There is also an article on the European Organization for Nuclear Research, through which 12 European nations will combine their resources to enable young European scientists to keep up with this new science.

As the editorial of the *Courier* states, "The frontiers of man's knowledge are now within the atom.... The scientific facts and principles explained are truly an expansion of man's universe. As the great explorers mapped the earth, and the astronomers of to-day chart the sky, so the atomic scientist, delving into matter and energy, has discovered an unknown world that is a revelation for philosophers and a vast resource for future generations. No educated person can afford to ignore these facts."

# NEW ORGANIC REMAINS FROM THE VINDHYAN SYSTEM AND THE PROBABLE SYSTEMATIC POSITION OF *FERMORIA*, CHAPMAN

M. R. SAHNI AND R. N. SHRIVASTAVA

*Geological Survey of India*

THE material upon which the following study is based was collected in 1950 by the senior author from the Vindhyan strata of Neemuch District, Central India. The main object of the study was to find evidence concerning the true phylogenetic relationship of the genus *Fermoria,* a problem that has so far baffled palæontologists and palæobotanists alike. Evidence is now forthcoming which appears to prove the algal nature of the genus. In addition, a new genus which we propose to name *Krishnania,* probably related to *Fermoria,* is described. We also examined, in peel sections, some material already collected by Jones from near Rampura, Neemuch District. The peel sections likewise suggest the plant nature of the genus *Fermoria.*

F. Chapman[4] (1935), examined these carbonaceous discs in detail and identified them as true brachiopods. He created the genera *Fermoria* and *Protobollela* for their inclusion and tentatively assigned them to the order Atremata.

A chemical test on these carbonaceous bodies was made by C. Ampt for the detection of ammonia, in order to ascertain the presence of chitinous substance. Although the test for ammonia was positive, it could not be ascertained, beyond doubt, whether this came from the fossil or the shale itself, which also gave a very strong reaction for ammonia. The nature of the test, therefore, remained inconclusive.

In the same year (1935), M. R. Sahni[5] re-



FIG. 1. *Fermoria* attached to apparently convergent filaments (× 2).
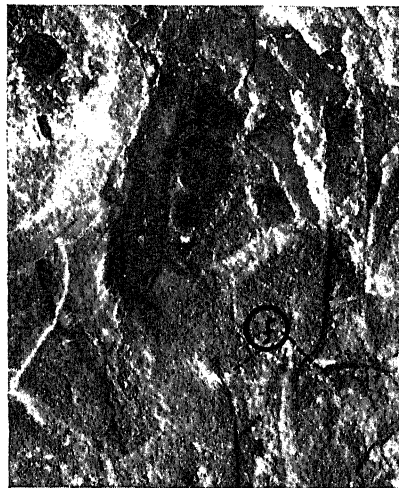
FIG. 2. Filament showing the funnel-shaped end (*f*) with *Fermoria* at the other extremity (×2).

Much controversy has centred around the nature of these discoidal remains. In 1909, H. C. Jones,[1] expressed the view that these fossils might belong to the genus *Obolella* or *Chuaria circularis* described by Walcott, from the Pre-Cambrian of Arizona, or that they might possibly be the operculum of *Hyolithellus.* In 1927, C. D. Walcott and G. E. Resser[2] thought that these fossils were definitely brachiopods, closely related to the Cambrian genus *Acrothele.* Later, in 1928, B. F. Howell[3] tried incineration tests and tentatively assigned them to the blue green algæ, comparable to Walcott's genus *Morania,* of Cambrian age.

vised Chapman's type material at the request of Sir L. L. Fermor, then Director, Geological Survey of India. He came to the conclusion that these fossils did not exhibit any character which would enable their assignation to the brachiopoda, there being no evidence whatsoever of a pedicle apex or growth lines, as suggested by Chapman. He placed these fossils under a new family, the *Fermodiidæ.*

In 1950, R. C. Misra[6] tentatively suggested that these fossils may be the remains of Ostracods. Recently, Misra[7] (1952) has modified his opinion about the nature of these disc-like bodies. On the strength of incineration tests

and the great variability of their size and shape, he regards them as simple mineral encrustations. He further supports their inorganic origin by the observation that they increase in size with the increasing coarseness of the embedding shale, thereby implying that it was progressively easier for mineral matter to be injected into coarser rocks.

In view of the divergence of opinion, a detailed examination of some of the material collected in 1950 was undertaken. While the vast majority of the *Fermoria*-bearing slabs showed isolated specimens of normal type, though of varying size, we were fortunate to discover examples of discs intimately associated with broad filaments. There is little doubt that the discs and the filaments are in organic union with each other. In nearly all cases, a single filament is seen associated with a single disc. However, in one case, the orientation of the filaments is very suggestive of a composite individual, about ten filaments (each terminating in a single *Fermoria*-type of disc) apparently tending to converge on to a single point (Fig. 1). No actual union of the filaments is, however, noticed in the direction of convergence.

The best preserved specimen (Fig. 2) shows a filament about 1·85 cm. long and 3 mm. wide. (These dimensions appear to represent the average of the filaments observed.) The filament widens appreciably towards one end where it becomes funnel-shaped and is 6 mm. across. The other end terminates in a small disc about 3 mm. in diameter. The disc is in some cases smaller than the width of the filament and thus gives the impression of being embedded in the filament, rather than being terminal in character. These discs are identical with *Fermoria* in shape and general character and are suggestive of spores. There are several other examples which exhibit the same funnel-shaped termination. To the left of the specimen shown in Fig. 2 may be seen three specimens of *Fermoria* in juxtaposition with each other, and of graded size. It is, however, uncertain whether the graded, chain-like arrangement is natural or a mere coincidence. The latter alternative appears to be more plausible.

Although several filaments have been examined, none of them show any trace of septa. Nor has any other cell structure been observed. The general characters of the fossils indicate that we are dealing with plants, possibly algæ. Another interesting structure has been observed in peel sections which also appears to indicate that the discs to which the name *Fer-*

*moria* has been given, are spherical bodies and that the so-called growth-lines (which are not truly concentric as sometimes claimed) are in fact relatively thicker tissue to serve as reinforcement and give strength and rigidity to the spore. Careful observation has shown that these reinforcing tissues converge on to at least two points on the disc (Fig. 3). Obviously only one side of the disc can be properly examined.

The suggestion by R. C. Misra that *Fermoria* represents inorganic encrustations appears to be controverted by the fact that discs of varying size occur in the same slab, irrespective of the coarseness of the grain of the rock. These are obviously individuals at different stages of growth.

Chemical tests are being carried out by Mr. P. D. Malhotra, in the Laboratory of the Geological Survey of India, and a fuller report will follow.
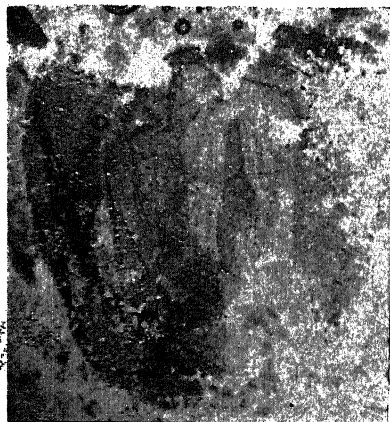


FIG. 3. Peel section of *Fermoria* showing reinforcement tissue (× 20).

FIG. 4. *Krishnania acuminata,* gen. et sp. nov. Genoholotype (G. S. I.) (× 2).

Family ? *Fermoriidæ,* Sahni, M. R.
*Krishnania acuminata,* Gen. et sp. nov.

There is a well preserved specimen (Fig. 4) and another partly preserved one in the fossil collection under investigation which undoubtedly represents a new genus, and probably belongs to the *Fermoriidæ,* Sahni.

*Diagnosis.*—The fossil is acuminately ovate in shape. Its longest axis measures 7·5 mm., its maximum width being 4 mm. It narrows somewhat abruptly at one end, but is evenly rounded at the other. In general outline, therefore, it bears a resemblance to *Lingula,* but the similarity is superficial and no relationship is implied. A characteristic feature of the genus is a deep, marginal furrow, more prominent on one side (probably due only to better preserva-

tion here) and apparently continuous all round. In places, there appears to be a fine subsidiary elevation within the furrow, which thus becomes divided into two.

The general shape, large size and sharp acumination separates this genus from *Fermoria*. The marginal furrows, too, are distinct from the lines seen in the peripherial portion of *Fermoria*, to which reference has been made above.

1. *Rec. Geol. Surv. Ind.*, 1909, **38**, 66.
2. *Ibid.*, 1927, **60**, 18.
3. *Ibid.*, 1928, **61**, 21-22.
4. *Ibid.*, 1935, **69**, Pt. 1, 109-20.
5. *Ibid.*, 1935, **69**, Pt. 4, 458-68.
6. *Micropalæontologist*, 1952, **6**, No. 1.
7. *Sci. and Cult.*, 1952, **18**, 46.

## SLIDES FOR PROJECTION

DURING the celebration of the session of the Indian Science Congress at Hyderabad, the members of the Botany Section were often shown tables and diagrams through the epidiascope; this method of projecting such tables is commonly accepted as a good substitute for the rather expensive one of preparing slides by photography, but in general the method leaves much to be desired, even when the epidiascope is in perfect condition; the text or table is not properly centered, or is upside-down, or the paper original curls up and goes partly out of focus, etc.

To obviate these difficulties the present author has been using a few methods for many years, which are given below in the hope they may be of use to others as well.

(1) *Tables with Text or Numbers.*—Take a sheet of cellophane paper such as is used for wrapping cigarrette or sweet packets; the paper should be even, without folds or creases. (In the Bombay market, and possibly elsewhere, the paper is available in sheets about 2-4 times the size of foolscap, and costs only 4-8 annas per sheet.) Next, take a sheet of fresh carbon paper, and fold it through the middle so that the carbon surfaces are inside and touch each other. Place a sheet of cellophane paper of convenient size in between the two folds of the carbon paper, and place the whole in the typewriter; remove the ribbon, as is done in the case of waxed sheets for the cyclostyle. Type directly on to the carbon paper, taking care that the text does not go beyond the size of the slides. The result is a clean typed sheet that will project with great luminosity. Place this sheet of cellophane between two slides and insert into the projection machine.

(2) *Diagrams in one or more colours.*—There are available in the market a number of inks that can write directly on any clean sheet of glass. I have used for years "Gold Seal Laboratory Ink", with very satisfactory results. With these inks it is possible to write directly on glass which has not been prepared in any way other than a thorough cleaning. There are several colours of these inks, so that rather complicated and artistic slides can be prepared with them. After writing on the glass, allow the ink to dry properly, and project as soon as necessary. The glass slides can be handled safely, as the ink hardens to almost the consistency of the glass itself.

Where such special inks are not available, Indian ink can be used with almost similar results; but in this case the glass slide has to be prepared to receive the Indian ink. There are several methods of preparing the glass: in photographic shops one often finds a good solution that serves very well. Canada balsam diluted thinly with xylol also serves the purpose: smear the slide with the solution and allow to dry *completely*; if the slide is placed in an oven at 50 or 60° C. for about 3 hours, the slide is generally ready and dry. If Canada balsam is not readily available, smear the white of the egg on the glass surface, and allow to dry. The slide is ready to receive writing with Indian ink, provided its surface is properly dried before Indian ink is applied to it.

H. Santapau.

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  Bombay

# THE OCCURRENCE OF C8-UNIT IN NATURAL PRODUCTS

## K. AGHORAMURTHY AND T. R. SESHADRI

### Dept. of Chemistry, University of Delhi, Delhi

THE origin of the $C_8$-unit (orsellinic unit) (I) and the various modifications it can undergo were made the basis of a theory of biogenesis of depsides and depsidones widely occurring in lichens.[1] Four of the derived units were originally recognised (II $a$, R = $CH_3$), (II $b$, R = $CH_2OH$), (II $c$, R = CHO) and (II $d$, R = COOH); other variations (III and IV) seem also to exist, e.g., orsellinaldehyde (III) has been recognised to constitute a unit in pannarin.[2] Later modifications involving nuclear methylation, nuclear oxidation and depside and depsidone formation following accepted rules of organic chemistry explain the evolution of all known members.



(I)



(II)
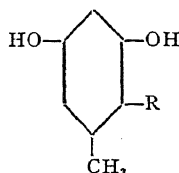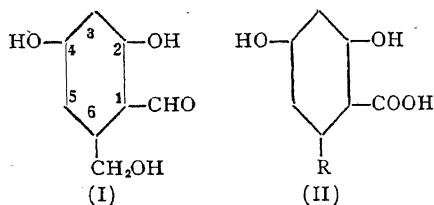


III, R = CHO, IV, R = $CH_3$

A large number of compounds found in lichens also occur in moulds, e.g., erythritol, β-carotene, ergosterol, polyporic acid, physcion, endocrocin and thelephoric acid. Further there is close structural similarity between a number of mould products and lichen substances. Consequently various features in the evolution of compounds of the two groups may be expected to be more generally common and the $C_8$-unit expected to be present in the mould products also. This is supported by a careful examination of structures of compounds belonging to different categories. However there is this difference that decarboxylation and nuclear reduction are found to occur more widely in the evolution of mould products. For the present purpose they are considered under four categories.

(1) BENZENE DERIVATIVES : These number more than twenty. Sparassol (V) and dihydroxy phthalic acid (II $d$) (DHP) are obviously simple derivatives of the $C_8$-unit. The three ketones

(VI $a$, $R_1$ = H, $R_2$ = CHOH.$CH_2$.$CH_3$), (VI $b$, $R_1$ = H, $R_2$ = CHOH.CO.$CH_3$) and (VI $c$, $R_1$ = H, $R_2$ = CO.CO.$CH_3$) occurring in Penicillium brevi compactum[3] exhibit chain lengthening of the alkyl group in the 6-position, a feature noted in the case of lichen acids also. An extra step of nuclear oxidation in the 5-position is found in ustic acid (VI $d$, $R_1$ = $OCH_3$, $R_2$ = CHOH.CO.$CH_3$).



(V)



(VI)
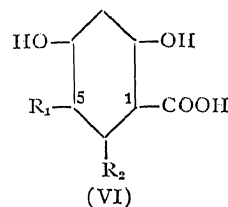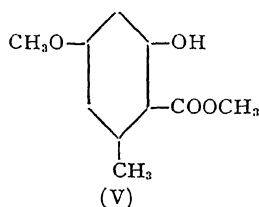
β-Orcinol derivatives of lichen acids have an alkyl group in the 3-position, whereas in mould products both the 3- and 5-positions carry side chains in various states of oxidation. Cyclopolic and cyclopaldic acids (VII $a$, $R_1$ = OH, $R_2$ = $CH_2OH$ and VII $b$, $R_1$ = OH, $R_2$ = CHO) are the simplest examples ; in the evolution of citrinin (VIII) and mycophenolic acid (IX) further changes are involved.



(VII)



(VIII)



(IX)
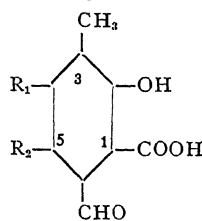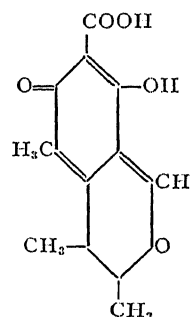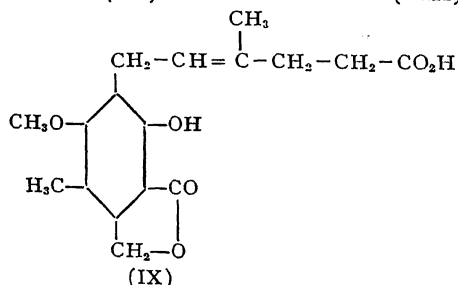
6-Methyl salicylic acid (X $a$, R = $CH_3$) and mellein (X $b$, R = CHOH.$CH_2$.$CH_3$) are products of nuclear reduction in the 4-position of the

earlier orsellinic systems. Actually it is quite easy to prepare the former in the laboratory starting from orsellinic acid. As belonging to this group could be mentioned gladiolic and dihydro gladiolic acids (VII $c$, $R_1 = H$, $R_2 = CH_2OH$ and VII $d$, $R_1 = H$, $R_2 = CHO$). Flavoglaucin (XI $a$, $R_1 = C_7H_{15}$, $R_2 = CO.CH = C\begin{smallmatrix}CH_3 \\ CH_3\end{smallmatrix}$) and auroglaucin (XI $b$, $R_1 = (CH = CH)_3$, $CH_3$ $R_2 = CO.CH = C\begin{smallmatrix}CH_3 \\ CH_3\end{smallmatrix}$) are also two related toluquinols coming under this category but having other modifying features. From these types gentisyl alcohol (XII $a$, $R = CH_2OH$) and gentisic acid (XII $b$, $R = COOH$) can be derived by using a stage of decarboxylation.



(X)  (XI)  (XII)  (XIV)
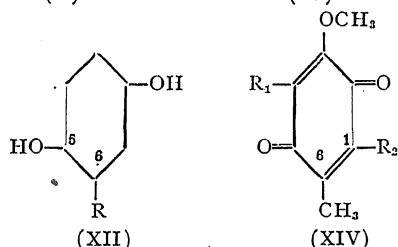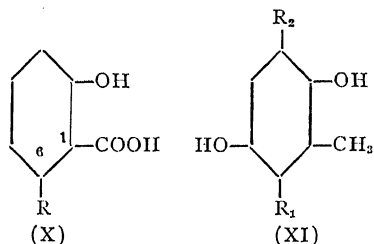
(2) QUINONE DERIVATIVES : Quinones occur usually in association with quinols and obviously constitute oxidation-reduction systems. Many of them contain C-methyl groups and seem to be capable of derivation from the orsellinic unit. As important intermediates may be mentioned 3- and 5-hydroxy orsellinic acids whose evolution by nuclear oxidation has already been discussed.[4] Fumigatin (XIII $a$, $R_1 = OH$, $R_2 = H$) could be developed from 3-hydroxy orsellinic acid through stages involving oxidation and decarboxylation. From fumigatin to spinulosin (XIII $b$, $R_1 = R_2 = OH$) is an easy stage involving *para*-nuclear oxidation and to 4-methoxy toluquinone (XIII $c$, $R_1 = R_2 = H$) is a stage of nuclear reduction. Aurantiogliocladin (XIII $d$, $R_1 = OCH_3$, $R_2 = CH_3$) would represent an example in which the group in the 1-position has undergone reduction to a methyl; it has the derived orsellinic unit (IV).

(3) ANTHRAQUINONE DERIVATIVES : Among mould products, the anthraquinone derivatives occupy a special place. They seem to be very readily formed from glucose in very high yields and some moulds contain them in very high percentage (30 per cent.). A study of lichen and mould anthraquinones leaves no doubt about their evolution from two orsellinic units. Almost invariably DHP constitutes one of them, the other being variable. Probably the simplest combination is provided by sulochrin (XIV) which is a benzophenone derivative. Compounds of the frangula emodin group (having 2-methyl as well as 2-hydroxymethyl groups) (XV) should be evolved by the nuclear reduction of the second unit of the intermediate (XVI) and subsequent anthraquinone ring closure.



(XIV)  (XVI)  (XV)  (XVII)
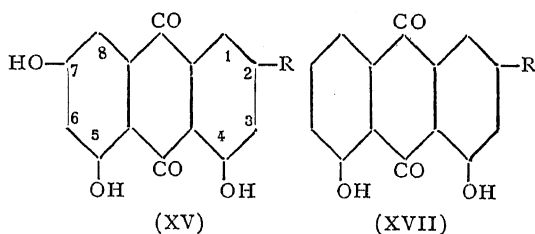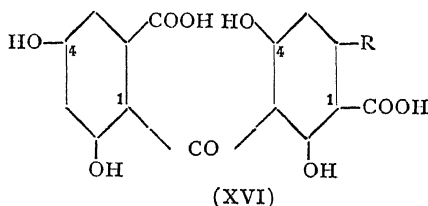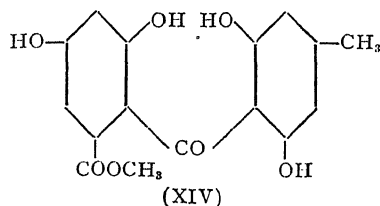
Chrysophanol derivatives (XVII) differ from the above in having no hydroxyl groups in 7-position. Though they are thus simpler in structure, they should be considered to involve more stages in evolution. They are the result of nuclear reduction in both the concerned orsellinic units in the 4-position. Rhodocladonic acid and solorinic acid are obviously $\beta$-orcinol derivatives.

(4) MIXED TYPES : There are other compounds which could be classed under mixed types having only one orsellinic unit, the other component being different. Under this category come grisefulvin (XVIII) and citromycetin (XIX).

In the formula of these compounds the orsellinic units are indicated as (A).



(XVIII)



(XIX)
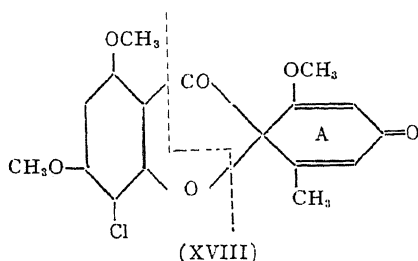
The wide occurrence of the orsellinic unit ($C_8$-unit) in lichen and mould products is thus established. It should be considered to be as important as other well known units already fully recognised to be present in natural products.
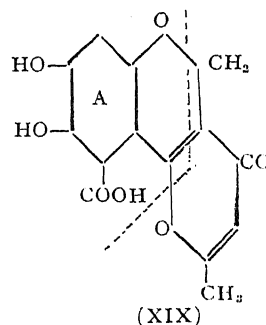
1. Seshadri, *Proc. Ind. Acad. Sci.*, 1944, **20A**, 1.
2. Yosioka, *J. Pharm. Soc. Japan*, 1941, **61**, 332.
3. Oxford and Raistrick, *Biochem. J.*, 1932, **26**, 1902; 1933, **27**, 634 and 1473.
4. Aghoramurthy and Seshadri, *Proc. Ind. Acad. Sci.*, 1952, **35A**, 327.

# REVIEW OF WORK OF THE NATIONAL LABORATORIES

THE programme of industrial development, which the Planning Commission has laid down for 1951-56, assigns important responsibilities to the work of India's National Laboratories, where research is being carried on in such varied fields as food, housing, roads, metals, glass and ceramics, industrial chemicals and others. Some of the less technical results of research achieved so far there are reviewed below :—

The Central Food and Technological Research Institute, Mysore, has demonstrated that starch can easily be prepared from mango kernels, which are plentifully available in the Indian villages. A process has also been evolved by it for the preparation of a palatable and nutritious juice from cashew apples.

The *Indian Pharmaceutical Codex* compiled by the Central Drugs Research Institute, Lucknow, and published by the C.S.I.R. recently, constitutes an exhaustive survey of Indian drugs of vegetable and animal origin. Incidentally, the publication also provides India with her *first* national pharmacopœia.

Investigations at the Central Building Research Institute, Roorkee, have shown that coal ash, discharged from the boilers, can, after suitable treatment, be used for making cement mixes. About 10-12 per cent. of portland cement can thus be replaced by the ash and the resulting mixture used in making mortars and concrete.

The Central Glass and Ceramic Research Institute, Calcutta, has produced good quality sand-lime bricks from lime sludge obtained as a waste product during the manufacture of acetylene from calcium carbide. These bricks are stronger and more regular in size and shape than clay bricks and by the incorporation of various pigments they can be made in a variety of pleasing colours for use as facing bricks in buildings for decorative effects.

The Indian Bureau of Mines, in collaboration with the National Metallurgical Laboratory, Jamshedpur, has designed a plant for the beneficiation of low grade manganese ore for industrial units producing from 10-15 tons per day.

The National Chemical Laboratory, Poona, has evolved a method of preparing phosphatic fertiliser by the action of hydrochloric acid on phosphate rocks from Egypt and phosphatic nodules from Tiruchirapalli. The hydrochloric acid needed can be obtained from chlorine, large amounts of which are produced as a by-product by the Indian alkali plants.

The problem of sulphur has also engaged the attention of the Fuel Research Institute, Jealgora, which has located a valuable source. Research by the Institute shows that Nowrozabad coal contains pyrites which can be recovered without any extra expense in the normal washery treatment of the coal, and sulphur can be obtained from the pyrites. On the basis of 150 tons of coal washed per hour for 20 hours a day, about 50 tons of pyrites will be available which can yield about 25 tons of sulphur every day.

The Central Electro-Chemical Research Institute, Karaikudi, is now engaged in the work of developing processes for recovering aluminium

from scrap arising from aluminium ware and utensils' manufacture and from used and discarded aluminium vessels. The Institute has also made progress in preliminary experiments on the fabrication of special primary batteries characterised by many useful features such as high current and power output, prolonged cell life, lightness and wide operation range.

The most important tanning material used by the Indian leather industry is wattle bark and for this, the country is dependent on outside supplies. Intensive research by the Central Leather Research Institute, Madras, has located an efficient substitute in Karada bark.

In addition to advanced fundamental research, the National Physical Laboratory, New Delhi, has also been engaged in industrial research. It has evolved an improved gas carburettor of the automatic type capable of operating in conjunction with petrol carburettor but having independent control. A digester suitable for production of bone meal for use as fertilisers has also been designed in the Laboratory. The

Central Road Research Institute, New Delhi, is engaged in studies on road materials and construction techniques which will yield better roads at lower cost. The Institute is directing attention to the improvement of locally-made bricks for metalling rural roads by increasing their compressive strength and decreasing the formation of dust, which occurs through wearing of the brick metal.

To fill the gap between research and its industrial application, the Government has established a National Research Development Corporation. The main function of the Corporation is to exploit in the public interest inventions of the Council of Scientific and Industrial Research and its National Laboratories, inventions of other State-owned Research Institutes and of other research organisations like Commodity Committees. It will also afford facilities to universities and other research institutions, and where public interest so demands, to individuals also, to exploit their inventions.

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## ANTIBIOTICS

IN the course of a lecture delivered at the Indian Institute of Science, Bangalore, Professor E. B. Chain of Oxford traced the growth of antibiotics from the time that he and his group of workers demonstrated in 1940 that a mould product containing the active principle designated penicillin from *P. notatum* possessed remarkable curative properties. The strain was by no means new, having been isolated by Alexander Fleming earlier.

Professor Chain recalled how after preparing a somewhat purified product from the culture fluid he injected some 30 mg. into a mouse and expected it to die. The greatest surprise was that it did not, and the experience was unforgettable. After the animal experiments, there were some dramatic cases of cure in hospital patients. These initial successes with penicillin inaugurated a new era in chemotherapy.

The chemical formula of penicillin proposed by Chain and Abraham was not initially accepted by any one. But elaborate studies with the aid of the X-ray diffraction patterns, Fourier analysis and interatomic distance measurements made later have only confirmed the original formula. The substance contains two amino acids, but wherefrom their wonderful properties are derived is not clear.

Attempts have been made recently to prepare biosynthetic penicillins by using different acids and constituents in the culture media.

The products behave in the same manner. Lately, a new type of penicillin, 'Cephelosporin', has been reported. It is different from penicillin, in that it gives $\alpha$-amino-adipic acid on hydrolysis, is also very active against gram negative bacteria, and is non-toxic. Further work on this is being watched with great interest.

Reviewing the work on other antibiotics, Professor Chain observed that Waksman had studied the properties of streptomycin isolated from cultures of *S. griseus* in great detail. In some cases of typhoid, it was found to be highly useful *in vitro,* but not *in vivo.* Pellmann of Mayo Clinic showed in a classical work that the antibiotic is effective against acute forms of tuberculosis. In most of the pulmonary cases, however, it produces resistant strains after two or three administrations. Prof. Chain also dealt at length with the phenomena of synergism in the action of antibiotics. A combination of penicillin and streptomycin has proved efficacious, while aureomycin with penicillin did not prove advantageous. Aureomycin and terramycin were instances of agents which had proved active against some viruses. It would appear that more antibiotics are needed urgently for the treatment of pulmonary tuberculosis and the virus diseases. Further advances will no doubt depend on fundamental progress in the field of chemical microbiology.

N. R. SRINIVASAN.

# LETTERS TO THE EDITOR

## PITCHSTONE FLOW IN RAJMAHAL HILLS, BIHAR

IN his letter published recently in *Current Science*, Raja Rao[1] records the existence of a pitchstone flow amongst the basaltic lava flows of the Rajmahal Hills. He is under the impression that this is the first recorded occurrence of a pitchstone flow in India.

Nevertheless, in my paper[2] on the "Lavas of Pavagad Hill" many years ago, I have described a specimen of pitchstone collected from this hill, broken from a loose block high up the mountain. On Pavagad Hill are seen flows of rhyolite, specimens of some of which are described in the paper, and there seems little doubt that the pitchstone described by me must have come from one of these acid flows.

It is of considerable interest that the basaltic flows of Rajmahal and of the Deccan Trap should both have had rhyolitic interludes. The microscopic details of the Rajmahal and Pavagad pitchstone sound similar. The specific gravity of my pitchstone is 2·54 as compared with the Rajmahal range of 2·400-2·538.

Also we must not overlook that Fedden as long ago as 1884, recorded the occurrence of trachy-felsites, pitchstone and obsidian in Kathiawar (*loc. cit.*, p. 169, and *Mem. Geol. Surv. Ind.*, XXI, pp. 96-98, the last page for a "bed of pitchstone").

Gondwana,                    LEWIS L. FERMOR.
Horsell, Surrey, England,
*December 23, 1953.*

1. Raja Rao, C. S , *Curr. Sci.*, 1953, **22**, 330.
2. Fermor, Lewis L., *Proc. Geol. Surv. Ind.*, 1906, **34**, 153.

## A NEW METHOD OF INTEGRATING SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

A NEW method which is in many ways superior to the existing ones, has been discovered for constructing solutions of second order linear differential equations, which may find considerable application in many branches of applied mathematics.

The process consists first in converting the given equation in the normal form,

$$\frac{d^2y}{dt^2} + f(t)\,y = 0 \qquad (1)$$

and then guessing an $n$th order approximate solution which fits in with the boundary value conditions of the problems. Let this solution be $y_n$. The $(n+1)$th order approximation will then be

$$y_{(n+1)} = y_n \cdot y_n'^{-\frac{1}{2}} \exp{-\frac{1}{2} \int \frac{f(t)\,y_n}{y_n'}\,dt}, \qquad (2)$$

where

$$y_n' = \frac{dy_n}{dt}$$

This process may be repeated indefinitely, and a solution of equation (1) may be obtained to any desired degree of accuracy.

It can easily be shown that if the above process is convergent, the limit, as $n$ increases actually satisfies the equation (1).

The author wishes to thank Sir J. C. Ghosh, for his interest, and to Dr. G. Bandopadhya, for helpful criticisms.

Dept. of Applied Chem.,        RANAJIT SEN GUPTA.
Indian Institute of Technology,
Kharagpur, *November* 22, 1953.

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## FLUCTUATIONS OF TEMPERATURE NEAR THE GROUND

THIS note gives a brief outline of the method adopted in recording the fluctuations of temperature near the ground. These fluctuations arise as a result of turbulence in the lower layers of the atmosphere and they are strongly correlated with the gradient of temperature and vanish as the gradient becomes small. The layer in which these fluctuations exist is explained as the 'Shimmering layer' by L. A. Ramdas[1] and an attempt has been made by the present worker to measure the fluctuations of temperature in the air layers near the ground. These fluctuations are recorded with the aid of a quick-run photographic recorder made by Messrs. P. J. Kipp and Zonen of Holland. The temperature is recorded with the aid of a 40 S.W.G. copper constantan thermo-

couple connected to a sensitive Moll galvanometer of period 1/5 of a second.

W. Hande[2] and many other workers took measurements of these fluctuations in temperature close the ground by using either platinum resistance thermometers or thermistors. P. K. Raman[3] has also recorded these fluctuations using copper constantan thermocouples but the method adopted by the present worker is slightly different. A thermocouple made of 40 S.W.G. copper constantan wires is coated with a thin



DESTRUCTION OF NOCTURNAL INVERSION– RECORDED ON 13-2-1953.
AT THE CENTRAL AGRI-MET. OBSERVATORY.
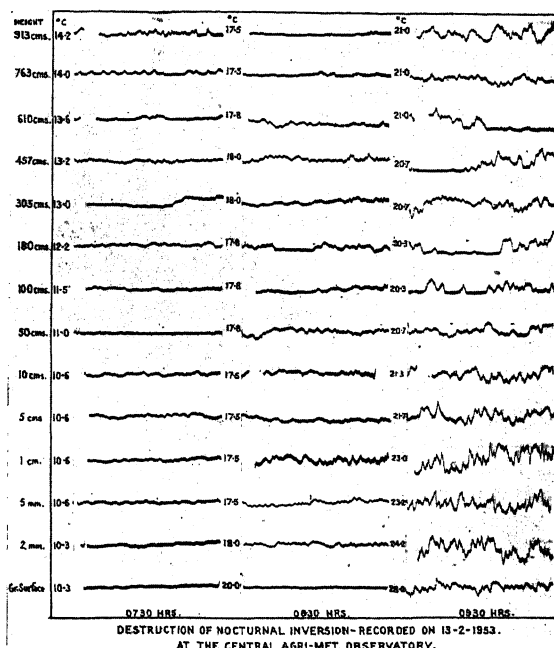
FIG. 1

layer of magnesium oxide to eliminate the radiation effects to the maximum extent possible. This thermocouple is connected in series with a sensitive Moll galvanometer of period 1/5 of a second. The deflections in the galvanometer are recorded by means of a photographic recorder. Using this technique, the characteristics of these fluctuations and their variation with height above the ground as well as with the time of the day are studied. These features have been briefly discussed by L. A. Ramdas[3] in a recent paper.

Fig. 1 shows a set of records taken during the destruction of nocturnal inversion on 13-2-1953. The mean temperatures in °C. at the corresponding heights are also marked. The records indicate the way in which the amplitude of these fluctuations increase with time as the inversion is destroyed. Similarly, a set of records were taken during the development of nocturnal

FLUCTUATIONS OF TEMPERATURE ABOVE THE GROUND (5cms)
RECORDED ON 23-10-1953 AT 1400 Hrs.
AT THE CENTRAL AGRI-MET. OBSERVATORY, POONA.
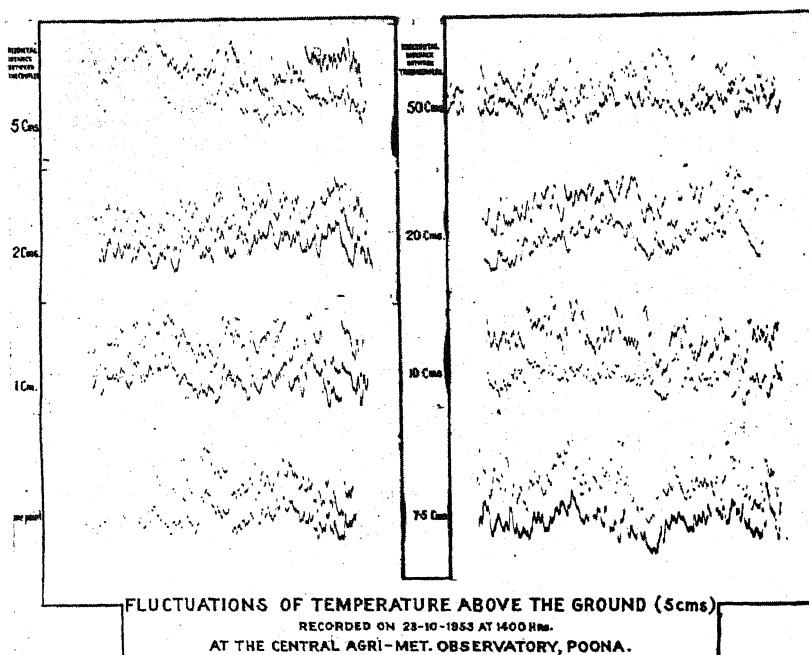
FIG. 2

inversion and they showed a decrease in amplitude as the inversion is setting in. These fluctuations go on decreasing as the inversion sets in and they are almost negligible in the inversion layer.

Fig. 2 shows a set of records of fluctuations of temperature recorded simultaneously by two thermocouples at the same height above the ground. Then by means of increasing the horizontal distance between the thermocouples in stages of 1 cm., 2 cm., 5 cm., 7·5 cm., 10 cm., 20 cm. and 50 cm. the fluctuations are recorded and they show that these fluctuations agree almost upto 7·5 cm. separation and beyond that there is a lag in these fluctuations. Further experiments are being conducted to find out the size of the eddies in relation to the nature of the ground. A detailed discussion of these will be published later on.

Grateful thanks are due to Dr. L. A. Ramdas for suggesting the problem and for the necessary guidance given.

Radiation Laboratory,      P. Krishna Rao.
Meteorological Office,
Poona-5, *November* 7, 1953.

1. Ramdas, L. A. and Malurkar, S. L., *Ind. J. Phy.*, 1932, 1.
2. Hande, W., *Beitr. Phy. d. fr. Atm.*, 1924, **21**, 129.
3. Raman, P. K., *Proc. Ind. Acad. Sci.*, 1936, **3**, 98,
4. Ramdas, L. A., *Ibid.*, Sec. *A*, 1953, **7**, 304.

## FURTHER STUDIES OF SAND MOVEMENT ACROSS WALTAIR BEACH

It has been found by La Fond and Prasada Rao[1] that sand oscillates around mean sea-level, and these short period oscillations in sand level are mainly related to tide range. Further investigations showed that the Beach in addition to undergoing such short-period cyclic changes, also undergoes long period erosion cycles. In the calm months of January and February, the Beach stands higher, while during the months of July and August it retreats. This has been observed at two stations, one near Andhra University (Fig. A) and the other near Scandle Point (Fig. B).
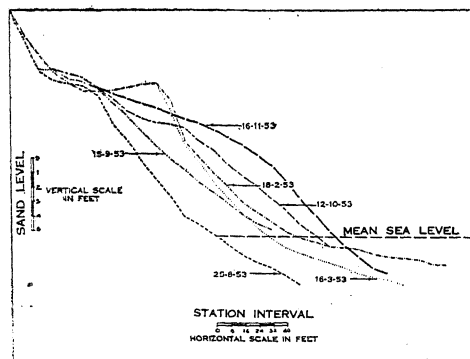


FIG. A. Profiles of beach taken over a number of months near Andhra University.

Apparently the Beach is built during the period following September and October and the fill attains a maximum in February, whereas the Beach begins to retreat from May and attains an equilibrium in August-September. Further, high waves cut the Beach while low waves build it up. High waves not only wash the Beach higher than the low-surf, but also gain speed during the backwash because of the farther movement of the 'Swash', extending upto the backshore (Figs. A and B), thus taking much of the sand from the foreshore and backshore.
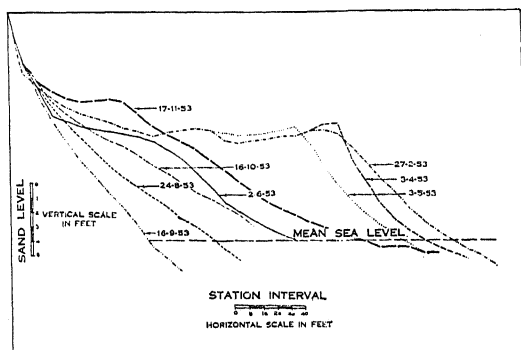


FIG. B. Profiles of beach taken over a number of months near Scandle Point.

TABLE I

*Monthly average wave height*

| January | 1′ 3″ | June | 3′ 0″ |
| February | <1′ | July | 2′ 9″ |
| March | 1′ 11″ | August | 2′ 10″ |
| April | 1′ 8″ | September | 1′ 9″ |
| May | 3′ 1″ | October | 2′ 1″ |

Between January and April when the height of the waves is quite low (Table I), the Beach is built, while during the months following May the Beach is cut by high waves. Also the rise in sea-level is partly responsible for the Beach retreat. The sea-level is very low during January and February[2] (when the Beach stands higher) and rises during the months following May. Sea-level is an important factor because the changes are considerable and it has been reported[2] that the Bay of Bengal has the greatest annual cycle of sea-level of any place in the world.

Another probable reason for the cutting of the Beach during the months following April may be due to the stopping of the dredging operations and the obstruction of sand movement along the coast by the break-water built across the harbour channel.

It has been observed that Beach 'B' which is full of submerged rocks is cut more swiftly and the cut is more pronounced than in 'A' which is a sandy Beach free from all obstructions. This may be attributed to increased turbulence when the waves strike the rocks, thus putting more sand into suspension. When the sand is in suspension it can be easily moved by the long-shore currents or on-shore and offshore circulation. This is especially true in May when the wave energy is greater.

Hence it is believed that the relative change in wave energies utilized in putting sand in suspension in the two seasons is mainly responsible for the difference in the amount of sand eroded in the two Beaches.

It has yet to be investigated whether the eroded sand is deposited in the deeper offshore area below the low tide level or if it is carried away northwards by the currents. Further studies are in progress.

The author wishes to express his gratitude to Prof. C. Mahadevan for his constant help in the work and to Mr. E. C. La Fond of U.S. Navy Electronics Laboratory, for his constructive criticism and keen interest he has taken in the work.

Dept. of Geology,    R. PRASADA RAO.
Andhra University,
Waltair, *December* 23, 1953.

1. La Fond, E. C. and Prasada Rao, R., *Curr. Sci.*, 1953, **22**, 264.

2. —, *Ibid.*, 1953, **22**, 333.

## ROTARY CURRENTS

ON several oceanographic cruises conducted by the Faculty and students of the Andhra University in the Bay of Bengal, an unusual surface phenomenon was observed. The water surface was composed of long streaks of alternating smooth and rough water, these streaks in some cases extending to the horizon. They varied in number from two or three to at least ten. Individual streaks varied in width from an estimated 75′ to 600′. Their orientation was always parallel to the coast, which is in the direction of the prevailing drift.

On one of these cruises on 13th December, a series of rough and smooth surface streaks was observed near the northern end of the Swatch of No Ground at 21° 18·5′ N. and 89° 33′ E. and off the mouths of Ganges. They were oriented in an east-west direction, and their relative motion with respect to the ship was from north to south. The width of each rough band was

approximately 75′ whereas the smooth band was about 100-150′. The surface was rougher on the southern boundary of the rough band.

As the ship drifted across these rough and smooth streaks, repeated bathythermograph (BT) observations in the form of continuous temperature-depth curves on a smoked slide from surface down to around 200′ were made. Two such curves were recorded for each observation, one called the "Down Trace" while lowering the instrument and the other, the "Up Trace" while raising the instrument.

It was found that the descending and ascending traces did not coincide with each other but in most cases were widely separated. This is believed to be due largely to differences in position of observation. Therefore the temperatures from both the "Up" and "Down" traces were plotted according to their relative positions under the bands of rough and smooth water. The nature of the trace, whether it is an "Up" trace or a "Down" trace was ascertained by examination with a magnifying glass.

From the resulting vertical temperature structure obtained by the repeated observations and from noting the direction of surface current it is concluded[1] that these long bands of alternately smooth and rough surface water have a rotary motion and are named "Rotary Currents" (Fig. 1). Their flow is in the form
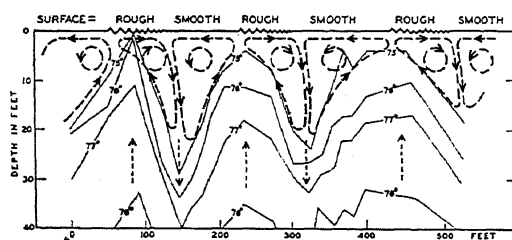


FIG. 1.

of interlocking spirals with their axes in the direction of the prevailing long shore current. This creates lines of convergence where the interlocking surface flows are towards each other and lines of divergence where the flows are away from each other. The vertical thermal gradients produced show deeper layer depths and sharper thermoclines in areas of convergence than in areas of divergence.

Rotary Currents are believed to be developed in the turbulent region where off-shore tidal currents come in contact with the prevailing coastal currents. At the time of BT observations at the afore-mentioned station, the tide was ebbing and setting the ship to the south. It is believed that the diluted estuarine water

flows out on the surface in waves. At the outer boundary of the wave, turbulence exists and with the prevailing east to west flow of the off-shore water, the turbulence is developed into rotary currents.

Rotary Currents have also been observed along the coast for 500 miles to the south. Whether they are developed *in situ* or are the remnants of up-stream features is not known. It is possible that other rivers or shallow coastal areas may also discharge water in gushes normal to the long shore current which develop into new rotary currents.

A detailed paper is under publication.

Andhra University,          EUGENE C. LA FOND.
Waltair, India,                C. BORRESWARA RAO.
*January* 2, 1954.

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## RELATIVE VISCOSITY AS A PURITY TEST FOR MUSTARD OIL

IT is well known that mustard oil, with the exception of castor oil, is of unusually high viscosity, and that determination of this physical property is useful in detecting adulteration of this oil with other vegetable oils, as a low value would indicate such adulteration.[1] This is of particular value when adulterants, for which no reliable specific tests exist, are present in comparatively small amounts. Examples are niger seed oil, safflower oil, etc. Presence of these as also of other oils lowers the viscosity of pure mustard oil, and inference could be drawn that the mustard oil is not genuine.

There are many varieties of rape and mustard seeds, but for extraction of oil for edible purpose *Brassica napus, B. campestris* and *B. juncea* are used commercially in this country.[2] In the present work most of the samples were extracted from these three varieties, only a few being taramira oil. Of the several methods for determining viscosity each have its particular advantage. In routine analysis where large number of samples have to be examined sometimes simultaneously it was found most convenient to determine the *relative viscosity, i.e.,* the viscosity of the oil relative to that of distilled water. The figure was easily arrived at by noting the time of flow of the oil through a capillary and that of water through the same capillary (Ostwald tube was used). Experimental details and calculations are given in

standard text-books.[3] The Ostwald capillary tubes were placed in a thermostatic bath and the temperature of determination was 40° C. The oil was filtered through a *triple* filter prior to the determination.

Results are summarised in Table I.

TABLE I

*Relative viscosity of mustard and other common vegetable oils at 40° C.*

| Type of oil | | Relative viscosity |
| --- | --- | --- |
| Mustard oil | (nearly 100 samples) | 60·2 to 63·0 |
| Groundnut | (7 samples) | 51·0 to 52·0 |
| Cocoanut | (average of 2 samples) | 34·8 |
| Linseed | ( ,, ,, ) | 36·0 |
| Safflower | ( ,, ,, ) | 40·8 |
| Nigerseed | ( 4 samples) | 46·2 to 47·4 |
| Castor | ( ,, ) | 346 to 357 |
| Sesame | ( 5 samples) | 46·0 to 47·6 |
| Olive | ( 4 ,, ) | 52·1 to 53·0 |

Clearly therefore, if the relative viscosity of mustard oil at 40° C. falls materially below 60·0 its purity should be considered as doubtful.

This determination is of particular value where the usual constants, such as saponification and iodine values, refractometer reading, etc., fail. To quote a typical instance, a sample of pure mustard oil was adulterated with about 15 per cent. of niger seed oil. Upon analysis, the adulterated oil gave the following figures: Saponification value, 175·4; Iodine value, 105·3; Butyro refractometer reading at 40° C., 60·0; Relative viscosity at 40° C., 58·2.

The slightly higher figures for saponification and iodine values could not be taken as definite evidences of adulteration, because pure mustard oil may at times give such figures. However, a suspicion was raised which was confirmed by the low relative viscosity figure.

In choosing the lower limit for relative viscosity of mustard oil, some allowance will have to be given and a value of 59·0 may be reasonably accepted as the minimum. Figures lower than this should be definitely suggestive of adulteration.

West Bengal Public        S. N. MITRA.
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## INFLUENCE OF VITAMIN $B_{12}$ ON THE BIOLOGICAL VALUE OF RAW SOYA BEAN

RECENT investigations have brought out convincingly that vitamin $B_{12}$ is concerned in transmethylation.[1-6] In addition to improving protein utilisation, vitamin $B_{12}$ plays an important role in anabolic processes. Thus, it has been reported that vitamin $B_{12}$-fed chicks have less non-protein nitrogen and less amino acids in circulating blood than the controls not receiving the vitamin.[7] This suggests that vitamin $B_{12}$ contributes to increased feed utilisation. It has also been reported that vitamin $B_{12}$ enhances the biological value of a poor protein diet[8] and casein diet.[9]

It was of interest to determine whether the biological value of raw soya bean, which contains growth[10] and proteolytic inhibitors,[11] could be improved by supplementing with vitamin $B_{12}$. Biological value determinations were carried out employing the nitrogen balance method of Mitchell,[12] using cold defatted raw soya bean powder. The endogenous nitrogen excretion was determined by feeding a low protein diet (4 per cent. whole egg protein). The percentage composition of the diet employed was as follows: Osborne and Mendel salt mixture, 4 per cent.; fat (groundnut oil), 10 per cent.; sugar, 10 per cent.; pigment (ferric or chromium oxide), 1 per cent.; cold, defatted soya bean to give 10 per cent. protein; and starch to make 100 per cent. All the vitamins at the usual level were added. There were two groups of rats, each rat weighing about 80 g., grouped on the basis of the usual considerations. One group received the above diet while the other group received the same diet along with vitamin $B_{12}$ at 50 $\mu$g. per kilo of diet. The vitamin was added as a dilute solution to equal to the above concentration every day to the diet.

The biological values obtained with and without the vitamin supplement are 77·6 ± 1·8 and 48·6 ± 0·9. The results suggest that vitamin $B_{12}$ has not only helped in greater utilisation of the protein but also overcome the adverse effects of the inhibitors. The exact mechanism of action of the vitamin under these conditions is being studied.

In another study, two groups of albino rats were fed a good stock diet containing 0·25 per cent. iodinated casein for two weeks. After this period they were employed for determining the biological value of the raw soya bean flour, with and without vitamin $B_{12}$ supplement. The values obtained are, 77·4 ± 1·3 when

supplemented with $B_{12}$ and $66 \cdot 2 \pm 3 \cdot 1$ without the supplementation of $B_{12}$. Under the conditions existing with the group of rats which received iodinated casein for 2 weeks and where the biological value was determined without vitamin $B_{12}$ supplementation, the metabolism has been highly enhanced with a concomitant increase in the biological value.

In the above studies the amino acids excreted in the urine were also determined quantitatively using the circular paper chromatographic technique of Giri and Rao.[13] It was found that the concentrations of amino acids in urine per gram of protein intake was much higher in the case of the animals not receiving vitamin $B_{12}$, thereby lending further support to the view that vitamin $B_{12}$ increases the utilisation of protein.

Further work on the release of certain amino acids consequent on adding vitamin $B_{12}$ to raw soya bean flour is in progress. The detailed paper will be published elsewhere.

Our thanks are due to Professor K. V. Giri for his keen interest in the investigation.

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## STUDY OF THE ACTION OF ACID ON CHROMATE ION BY GLASS ELECTRODE

SOLUTIONS of chromic acid and chromates have been investigated by a large number of workers. The pH of a dilute aqueous solution of potassium chromate is above 8. Hydroxyl ions are produced due to the reaction $CrO_4^{--}+H_2O \rightleftharpoons HCrO_4^-+OH^-$. The pH of a dilute solution of potassium dichromate is less than 5. This low pH is due to the reactions $Cr_2O_7^{--}+H_2O \rightleftharpoons 2HCrO_4^- \rightleftharpoons 2CrO_4^{--}+2H^+$. These reactions have been studied by Brown and Cranston[1] by measuring the change in hydrogen-ion concentration on dilution of solutions of potassium chromate and dichromate. Neuse and Rieman[2] have studied the latter reactions by measuring the activity of hydrogen ion (by glass electrode) in the solutions of potassium chromate and dichromate mixed in various proportions. These reactions have also been studied by other methods.[3] Britton had studied[4] the reaction I by titrating chromic acid solution against standard alkali using hydrogen and oxygen electrodes.

In the present work, the change in the concentration of hydrogen ion on addition of known amount of acid to a known amount of potassium chromate solution was studied. Standard solutions of potassium chromate ($0 \cdot 09932$ M), nitric acid ($0 \cdot 05845$ N) and sulphuric acid ($0 \cdot 04794$ N) were used. Ammonium nitrate solution (2 M) was prepared from a G. R. sample. 10 ml. of potassium chromate solution were mixed with 50 ml. of ammonium nitrate and a known amount of acid was added. The resulting solution was diluted to 100 ml. The pH of the solution was measured by a Marconi pH meter. Experiments were not done above pH 6 as no arrangement could be made to eliminate atmospheric carbon dioxide. The readings are confined to the pH range $4 \cdot 5$-6.

Chromate ion reacts with hydrogen ion as follows :

$$CrO_4^{--}+H^+ \rightleftharpoons HCrO_4^- \qquad (1)$$
$$2HCrO_4^- \rightleftharpoons Cr_2O_7^{--}+H_2O \qquad (II)$$
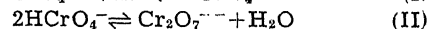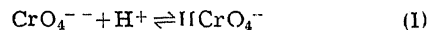
Hence addition of an acid does not increase the concentration of hydrogen ion appreciably. Practically the whole of the acid is consumed as if neutralised by a base. The ionic strength of the solutions would be governed by the ionic strength of ammonium nitrate which is in large excess compared to other ionic species. It can therefore be assumed that ionic strength is constant. Let $C_1$, $C_2$, $C_3$ and $C_H$ be the molar concentrations of chromate ion, hydro chromate ion, dichromate ion and hydrogen ion respectively and C the g. mol. of potassium chromate in 10 ml. of the solution used and $C_A$ the g. equivalent of acid added. Then

$$\frac{C_2}{C_1 \times C_H} = K_1 \qquad (1)$$

$$\frac{C_3}{C_2^2} = K_2 \qquad (2)$$

$$C = C_1 + C_2 + 2C_3 \qquad (3)$$

Change in pH is very small and hence we can assume that the whole of the acid added is neutralised by reaction I.

$$C - C_A = C_1 \qquad (4)$$
$$C_A = C - C_1 = C_2 + 2C_3 \qquad (5)$$

d $C_A$ are known, $C_1$ can be calculat-
(4). The determination of $C_2$ and $C_3$
ble directly. It is assumed that when
$C_3$ will be very small and $C_A$ would
early equal to $C_2$. But for other
would always be greater than $C_2$. In
on

$$\overline{\phantom{H}} = K_1' \qquad (6)$$

ys greater than $K_1$ and it is expected
ould approach the value of $K_1$ when
hes zero, *i.e.*, when $C_1 = C$. $K_1'$
calculated and plotted against $C_1$.
of $K_1'$ at $C_1 = C$ is taken as $K_1$. $C_2$
lculated from eq. (1), and $C_3$ by
$_2$ is then found from eq. (2). The
$K_1$ and $K_2$ obtained by using nitric
ric acids are given in Table I.

TABLE I

| Acid | Extrapolated $K_1 \times 10^{-5}$ | Mean value of $K_2 \times 10^2$ |
|------|------|------|
| $HNO_3$ | 5·43 | 1·71 |
| $H_2SO_4$ | 4·68 | 3·54 |

sting to note that the values of $K_1$
y $K_2$ are a little different in the two
reaction of dichromate ion with acid
vestigation.
ils will be published elsewhere.

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         S. PANI.

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**ATION OF GLUCOSE AND
ORBITOL BY PAPER
CHROMATOGRAPHY**

se of an investigation of electrolytic
f glucose to sorbitol, we had occa-
ply paper chromatography for the
f sorbitol.
ving systems were tried using What-
filter-paper with ascending runs for

l acetate-acetic acid-water 3 : 1 : 3,
tanol-acetic acid-water 4 : 1 : 4,
nol-pyridine-water 1 : 1 : 1, (4) *m*-
ol-water 4 : 2 : 1, (5) *m*-Cresol-
r 2 : 2 : 1, (6) Phenol-water 4 : 1.

In the first three systems, the $R_f$ values of
glucose and sorbitol were found to be nearly
the same, as were also found by Bradfield and
Flood,[1] Buchanan, Dekker and Long,[2] and
therefore no separation was possible. In the last
three systems, however, there was definite
separation, and the $R_f$ values obtained are as
follows :

| System | $R_f$ Sorbitol | $R_f$ Glucose |
|--------|------|------|
| *m*-Cresol-phenol-water 4 : 2 : 1 | 0·24±0·01 | 0·16±0·01 |
| *m*-Cresol-phenol-water 2 : 2 : 1 | 0·31±0·01 | 0·22±0·01 |
| Phenol-water 4 : 1 | 0·52±0·02 | 0·41±0·02 |

For the detection of sorbitol spots the spray
reagent containing bromocresol purple as re-
commended by Bradfield and Flood (*loc. cit.*)
has the disadvantage that the whole of the filter-
paper turns green after some time and the spots
fade out ; hence a new spray reagent was
searched for, and the following reagent was
found to be satisfactory. 33·3 ml. of 0·1 M boric
acid + 26·7 ml. of 0·1 M NaOH + 40 ml. of
methyl red indicator (0·02 per cent. in 60 per
cent. ethanol).
The chromatograms after developing were
dried over a hot plate for 3-4 minutes to expel
the phenols and sprayed with the reagent and
dried in a similar manner. Sorbitol gave red
spots immediately on spraying, while those due
to glucose were obtained after some time. The
red spots on a yellow background keep well
and do not fade out at least for a few days.
Further work with polyhydric alcohols and
carbohydrates is in progress. Full details will
be published elsewhere.
Our thanks are due to Dr. C. S. Patel for
his keen interest and helpful suggestions, and to
Miss S. R. Parkhi for the help rendered during
this work.

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*November* 28, 1953.

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**TRANSFRUCTOSIDASE FROM *AGAVE
VERA CRUZ***

IT has been previously reported from these
laboratories that the stem juice of *Agave vera
cruz* contains polyfructosans, besides a number
of simpler sugars as the minor constituents.[1]
Observations on an enzyme present in this plant
material which mediates in the building of

fructose polymers from sucrose are reported here.

On incubating the stem juice, as also the juice from the unopened primary leaf emerging centrally from the stem, with sucrose as the added substrate, it was repeatedly observed that the optical rotation of the reaction mixture (initially dextro-rotatory due to excess sucrose) progressively decreased, with a simultaneous release essentially of glucose as the free reducing sugar. Paper partition chromatography of the incubated mixture showed (*i*) a diminution in the concentration of added sucrose, (*ii*) formation of oligosaccharides between the sucrose and the zero spots, and (*iii*) an increase in the concentration of glucose. These observations were clearly suggestive of a dismutation of sucrose to fructose polymers by the intermediation of an enzyme present in the agave juice.

By step-wise precipitation of the stem juice with ammonium sulphate, the enzyme was concentrated about twenty-fold, and its characteristics studied. On dialyzing the concentrate and filtering, a cell-free, clear solution was obtained undiminished in activity, showing that no dialysable cofactor formed part of the enzyme system. None of the fractions obtained by using ethanol of different strengths was active.

Polyfructosan (isolated from the Agave) by itself or with sucrose, when incubated with the enzyme, remains unchanged proving that polyfructosan is not necessary for the reaction. Thus, the enzyme from this plant source differs fundamentally from the corresponding enzyme from Jerusalem artichoke which, according to Edelman and Bacon,[2] transfers fructose from inulin to sucrose. Incubation of the enzyme with glucose, fructose or their mixtures or with raffinose does not result in the formation of oligosaccharides. In this manner, this plant enzyme resembles the mould enzymes described by Bealing and Bacon.[3]

The optimum pH for the enzyme action is 5·6-5·8. The enzyme has maximum activity at 37° C. and gets inactivated at 55° C.

Four oligosaccharides are formed. Analysis of the spot immediately below sucrose has been completed and shows it to be made up of two units of fructose and one unit of glucose (*cf.* Dedonder,[4] Edelman and Bacon,[2] Pazur[5]). Quantitative analyses of the carbohydrate spots separated on the chromatogram confirm the stoichiometric relationships between sucrose and formed sugars as given by Dedonder[4] and Pazur.[5]

The authors wish to record their thanks to Dr. V. Subrahmanyan for his interest in the work.

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## ACIDS AND SUGARS IN THE 'KAMRAKH' FRUIT, *AVERRHOA CARAMBOLA*, LINN.

WINTON,[1] while quoting analytical data from previous reports[2,3] on *A. carambola*, doubts if oxalic acid is the free acid present in the fruit. Kalyankar and co-workers[4] found only malic acid by chromatographic analysis of the fruit extract. The tree belongs to the family Oxalidaceæ and the cells of the pericarp tissue of the fruit have within them small oxalate crystals.[1] It is definite that the fruit contains some amount of oxalic acid, free or combined, since the clear juice, on neutralisation and addition of calcium chloride solution, gives a white precipitate insoluble in acetic acid and capable of reducing acidified permanganate after dissolution in dilute sulfuric acid.

Extensive chromatographic studies with the sour and sweet varieties of the fruit collected from different sources, using the techniques of Giri and co-workers,[5] and Kalyankar and co-workers,[4] show that the sweet variety contains both oxalic and malic acids, while the sour variety contains only oxalic acid. Accordingly, quantitative determinations for malic acid and oxalic acid were done by the polarimetric uranyl acetate method and calcium oxalate method[6] respectively, using clear extracts from known weights of the fruits. Simultaneous determinations of moisture and reducing sugars[7] were also carried out (Table I).

Chromatographic analysis of the juice of both varieties of fruits for sugars, using the ascending

technique with butanol acetic acid water (4 : 1 : 5) as solvent mixture and benzidine trichloracetic acid as developer showed the presence of traces of sucrose, moderate quantities of fructose and large proportions of glucose.

TABLE I

| Variety of fruit | Moisture % | Reducing sugar % | Titrable acidity ml. of 0·1 N NaOH = 100 g. fruit | Oxalic acid % | Malic acid % |
|---|---|---|---|---|---|
| Sweet | 91·7 | 3·83 | 41 | 0·16 | 0·06 |
| Sour | 89·9 | 4·60 | 98 | 0·51 | ·· |

Most of the free acidity is due to oxalic acid as could be seen from the titrable acidity figures. A small percentage of the oxalic acid is perhaps present as sodium or potassium salts, the presence of any significant quantities of calcium oxalate being ruled out since the fruit has very low calcium content.[8]

The figures given above are for ripe fruits. The oxalic acid content of some unripe sour fruits runs as high as 1 per cent. It is relieving to note that only the sweet ripe fruits of low acid content are generally eaten as such, the sour variety being used for pickles and preserves.

The authors thank Dr. V. Subrahmanyam for his keen interest in the work.

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*November* 9, 1953.    D. S. JOHAR.

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## THE RELATIONSHIP BETWEEN FOLIC ACID AND BIOTIN

IN the course of our investigation on the biochemical functions of biotin, a member of the vitamin B complex, we found that it was able to overcome the growth inhibitory effects of the insecticide, γ-hexachlorocyclohexane, in the Ascomycete fungus, *Neurospora crassa*.[1] In order to understand more about the detailed mechanism of action of the insecticide, experiments were conducted to see whether other aspects of inositol metabolism were affected under the influence of γ-hexachlorocyclohexane. Although nothing definite is known as to the metabolic functions of inositol, the amount of the vitamin occurring in pancreatic amylase, as determined by Williams, Schlenk and Eppright,[2] is such as to suggest that it may be a component of the system. Lane and Williams[3] observed that the inhibition by lindane of pancreatic α-amylase was overcome by inositol, and this strengthened the above view that inositol may function as an integral part of the enzyme system. Although Fisher and Bernfield[4] were not able to confirm the suggestion using pure and crystalline malt and pancreatic α-amylase, Ramachandran and Sarma[5] observed in the course of their investigation on the synthesis of α-amylase by pigeon pancreas *in vitro*, that the insecticide inhibited the synthesis of the enzyme. Further, Dulaney and Grutter[6] indicated that inositol is the only vitamin that is able to increase riboflavin synthesis in Eremothecium ashbii, and that biotin and thiamin, which this organism normally requires for its growth, do not increase the riboflavin level over that obtained by inositol alone in the culture.

We have found in the present investigation using *Aspergillus oryzœ* as the test organism, that the two actions of inositol in the cell, production of amylase and riboflavin, are inhibited by γ-hexachlorocyclohexane, and that biotin is able to overcome the inhibitory effects to an appreciable extent, in conformity with our earlier observation.[1]

The organism was cultured on a modified Czapek-Dox medium and amylase and riboflavin were determined after ten days growth, amylase by the method of Somogyi[7] and riboflavin by the standard flurometric procedure as outlined by Scott, Hill, Norris and Heuser.[8] The organism was cultured in 250 ml. Erlenmeyer flasks containing 25 ml. of the basal medium and the inhibitor was made up in ethanol and added before sterilisation.

Studying the influence of the individual members of the B group of vitamins, it was observed that folic acid exerted an antagonistic effect with respect to biotin. In the presence of folic acid, it was found that γ-hexachlorocyclohexane inhibits the production of amylase and riboflavin by *Aspergillus oryzœ* to a far greater extent than in its absence, although folic acid by itself does not have any effect in the absence of the insecticide. The results, presented in Table I, indicate that while biotin is able to overcome the inhibitory effects of the insecticide

to an appreciable extent, folic acid augments the inhibitory action, and that, in the presence of folic acid, biotin in the concentration employed is not able to overcome the inhibition. A similar instance of antagonism between folic acid and biotin has been reported by Sreenivasan[9] relating to nucleic acid synthesis by *Lactobacilli*. Full details of this investigation will be published elsewhere.

TABLE I

*Relation of folic acid and biotin to γ-hexachlorocyclohexane inhibition in Aspergillus oryzæ*

| supplement/25 ml. | amylase units* | riboflavin γ/g. |
|---|---|---|
| Basal Medium (BM)—control | 2250 | 24·6 |
| BM + folic acid (5γ) | 2238 | 24·5 |
| BM + γ-hexachlorocyclohexane (1 mg.) | 1720 | 18·2 |
| BM + γ-hexachlorocyclohexane (1 mg.) + biotin (1γ) | 2060 | 21·8 |
| BM + γ-hexachlorocyclohexane (1 mg.) + folic acid (5γ) | 1410 | 16·5 |
| BM + γ hexachlorocyclohexane (1 mg.) + folic acid (5γ) + biotin (1γ) | 1450 | 16·3 |

\* mg. reducing sugar (glucose equivalent) formed by 1 g. mycelium in one hour at 37° C. at pH 5·6.

The authors wish to express their grateful thanks to Dr. W. H. Tisdale, and Messrs. Hooker Electrochemical Co., New York, for the gift of a 99 per cent. pure γ-hexachlorocyclohexane sample, and to Messrs. Hoffman La-Roche & Co., Inc., for synthetic d (+) biotin used in this investigation.

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University of Madras,     P. S. SARMA.
December 5, 1953.

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## PHYTOTOXICITY IN COTTON PLANTS DUE TO DDT SPRAYING

THERE is not much evidence of any phytotoxicity in cotton plants due to DDT spraying though some account of the same due to BHC is given by McKinlay.[1] Field experiments were conducted in the I.A.R.I. Farm during 1952-54 for the control of bollworms of cotton using 0·25 per cent. DDT and 0·0325 per cent. γ-BHC water suspensions at the rate of about 50 gallons per acre in fortnightly and monthly intervals. Spraying was started on 28-7-1952 and 18-8-1953 and continued till about the end of October during the two years respectively. In both the years in plots sprayed with DDT in fortnightly intervals the growth of the new leaves in many plants was checked and many leaves had assumed linear shape. The new flowers and bolls were also very much reduced in size. In addition, a good many buds and flowers were seen withering with a consequent lowering in the number of bolls set during the first year, such withering during the second year, however, being less marked. These abnormalities observed from about the middle of September were distinctly present in all the plots where DDT was sprayed in fortnightly intervals, the plots receiving DDT spray in monthly intervals or those receiving BHC in fortnightly or monthly intervals apparently not showing such abnormalities. These observations stress the need for caution in the use of DDT or BHC for the control of pests of cotton.

Div. of Entomology,     P. B. MOOKHERJEE.
I.A.R.I., New Delhi,
December 28, 1953.

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## PARTHENOGENESIS AND ALLOPOLYPLOIDY IN THE MELANIID SNAILS (GASTROPODA-PROSOBRANCHIA)

COMPREHENSIVE accounts of parthenogenesis among animals have been given recently by Suomalainen[1] and Peacock.[2] Among Molluscs only two instances of parthenogenesis, *viz.*, *Campeloma rufum* (Mattox)[3] and *Potamopyrgus jenkinsi* (Sanderson)[4] are known. In the latter polyploidy is probably combined with parthenogenesis, the continental race being a diploid, and the British race a polyploid. Polyploidy is not infrequent among parthenogenetic animals but they are all instances of autopolyploids. As White[5] has pointed out there is no

authenticated record of allopolyploidy occurring in nature in animals.

I have been studying the cytology of some of the Melaniidæ, a family of freshwater prosobranch gastropods. *Melania crenulata, Paludomous tanschaurica* and a few species of the *Melanoides* have been investigated. The latter prove to be of considerable interest, as they show parthenogenesis and evidences of allopolyploidy. A cytological study of *Melanoides tuberculatus* shows that the species is composed of two distinct races, a diploid one with $2n = 32$ chromosomes and a second race with 90-94 chromosomes, evidently at the hexaploid level. The phenotypic differences between these two races are slight, the diploid race having a slightly ridged shell and the polyploid a relatively smooth shell. These differences are not of sufficient importance taxonomically for regarding the two races as distinct species. Both the races are parthenogenetic. Over 10,000 specimens of the typical or diploid race have been examined without coming across a single male. In the polyploid race, however, exceptional males are met with occasionally, *i.e.*, about 3 per cent. of the population. The spermatogenesis of these exceptional males shows that they are all sterile as the spermatids undergo degeneration. Further interest is found in the abnormal meiotic phenomena of these males. In the first metaphase, a varying number of univalents, bivalents and some multivalents are present. The irregular distribution of the univalents is very characteristic at this stage (Figs. 1 and 2). The meta-

phase plates are strikingly similar to those observed in several plant hybrids. The heterozygosity of the race is further suggested by the presence of bridge and fragment mostly at the second division, indicating relatively inverted segments in homologous chromosomes. The race is therefore an authentic instance of allopolyploidy occurring in nature combining both structural and numerical hybridity. At diakinesis the multivalents show a ring-like arrangement (Fig. 3).
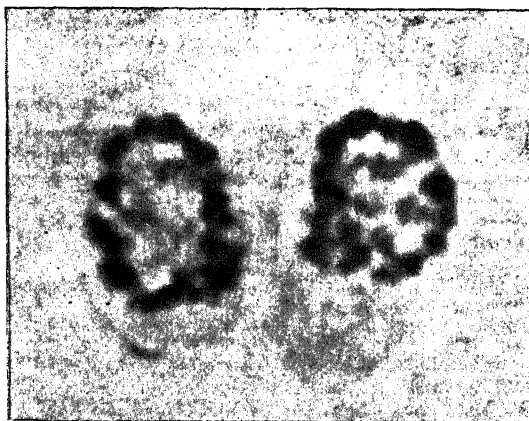


FIG. 3. Ring formation at diakinesis ( × 4,000).
(Acetocarmine preparation)

The other two species of *Melanoides* investigated, *Melanoides lineatus* and *Melanoides scabra,* are also parthenogenetic. Exceptional males are also met with in *Melanoides lineatus,* but they are much rarer, being about 0·01 per cent. of the population. These also show hybrid structure and are allopolyploids. *Melanoides lineatus* has 71-73 chromosomes and *Melanoides scabra* 76-78 chromosomes.

The occurrence of parthenogenesis in the species of *Melanoides* studied has been inferred, not only from the absence of males and absence of sperms in the oviduct and broodpouch, but also confirmed by the cytological investigation of the maturation divisions of the ovum and the early cleavage stages in development. The chromosome numbers before and after each of the two maturation divisions and at the first cleavage division have been checked with those in the polar body. The parthenogenesis is apomictic with two equational maturation divisions as in *Pycnoscelus surinamensis* investigated by Matthey,[6] but there is no pairing of chromosomes, and in the early prophase the leptotene chromosomes show a longitudinal split. Detailed observations on the mechanism
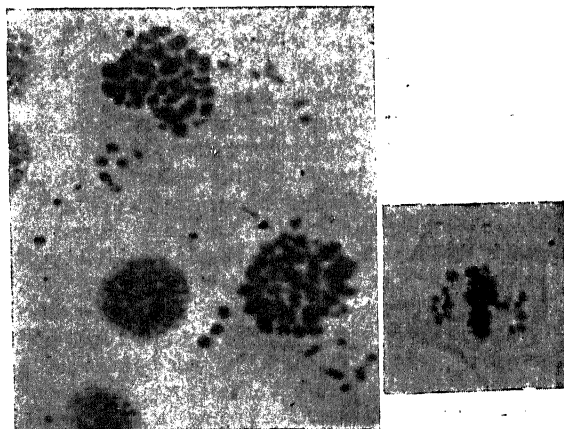


FIG. 1. Two metaphase-I plates Polar view (×1,100).
Univalents are lying scattered
(Acetocarmine preparation)

FIG. 2. Metaphase-I Equatorial view ( × 1,100).
Univalents near the poles (A Feulgen squash).

of parthenogenesis are in progress and will be reported shortly.

The habits of the two races of *Melanoides tuberculatus* are worth mentioning in the context of their chromosomal differences. The typical or diploid race occurs in very restricted localities, but the polyploid race has been collected from several localities in the Madras and the Andhra States, and from different habitats including wells with brackish water having a salinity of 24 ‰. No appreciable difference in cell-size could be detected between the diploid and the polyploid races. Further work including controlled breeding experiments is in progress.

My thanks are due to Prof. J. B. S. Haldane and Dr. H. G. Callan for suggestions, to Dr. H. S. Rao for verification of the species and to Prof. R. V. Seshaiya for guidance.

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Annamalai University,
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## SEX CHANGES IN THE WOOD-BORING PELECYPOD, *TEREDO NAVALIS* LINN.

THE phenomenon of sex reversal is of wide occurrence among pelecypoda. Calman[1] and others have stated in their account of Teredinidæ that while some species of *Teredo* are hermaphroditic, in others the sexes are separate. Protandry in *Teredo* has been indicated, although not recognised as such, since the work of Quatrefages nearly a century ago, who reported a proportion of only 5 or 6 males in each 100 individuals of *Teredo norvegica*. Nelson[2] later suggested an even greater disparity of the sexes, with as many as 500 females to 1 male among large individuals. Yonge,[3] on the other hand, found definite evidence of protandry in two specimens of *T. norvegica*. Coe[5,10] worked in detail on the sex problem in *Teredo* and came to the conclusion that protandry does exist in this form and 90 per cent. of the adult population are females. Grave[6,9] while agreeing with Coe in the occurrence of sex inversion in *T. navalis*, maintains that the gonads of the young are not exclusively male as

required by the conception of the sexual cycle as protandric. The sex, according to this author, is not rigidly fixed and there may be inversion of the sexes from male to female or from female to male at any time during the breeding season. In view of his findings Grave concluded that *T. navalis* is not essentially or principally protandric. Kofoid and Miller[11] observed that males of *T. navalis* in San Francisco Bay are commonly smaller than females, but found no evidence that actual change of sexual phase might occur.

From the above account, it is evident that all the workers are agreed that a change of sex in *Teredo* occurs but the whole controversy lies in the fact as to whether this change indicates protandry. For ascertaining this, we examined the gonads of 129 specimens of *Teredo navalis* of different size groups. The length of the animal after its removal from the burrow was measured and the condition of gonad ascertained. Some of the gonads of different size groups were fixed in Bouin's fluid and later sectioned and stained for detailed histological study.

The statistical data are given below :—

| Length of the animal | True males | Ambisexual males | Herma-phrodites | Females | Total |
|---|---|---|---|---|---|
| 1–20 mm. | 17 | 33 | 2 | 1 | 53 |
| 20–30 mm. | 6 | 2 | .. | 30 | 39 |
| 30–50 mm. | 5 | .. | 1 | 23 | 21 |
| 50 mm. and above | 1 | .. | .. | 8 | 9 |

The primary gonad is bisexual as Coe[4] stated with a cortical layer of potential ovogonia and a medullary group of spermatogenic cells in each follicle. In the first size group, out of 53 forms examined there were 17 forms which represent extreme aspect of masculinity in that the gonads have only a very few minute ovocytes along the walls of the follicles. Such individuals are called as "True males" (Fig. 1). The 33 ambisexual males are those forms in which the gonads reveal a highly variable proportion of spermatogenic and ovogenic cells (Fig. 2). There are only two hermaphrodites in the first size group which contains functional gametes of both types. The occurrence of a single female in the first size group is of considerable significance. According to Coe[7,8] such females make their appearance by omission of the initial male phase as it is known to be in some other species of normally protandric molluscs.

In the next size group there are 30 females out of 38 specimens observed (Fig. 3). Evi-
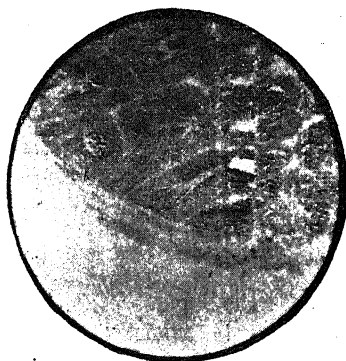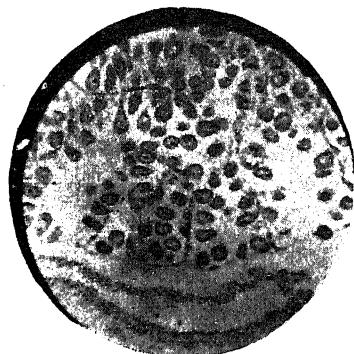
FIG. 1.  FIG. 2.  FIG. 3.

FIG. 1.  *T. navalis*, T. S. gonad showing spermatogenic follicles.
FIG. 2.  *T. navalis*, T. S. through hermaphrodite gonad showing cortical layer  of  large ovocytes with relatively small number of spermatocytes in centre.
FIG. 3.  *T. navalis*, T.S. gonad of female showing ova in the follicles.

dently these are the few forms which have changed their sex from the initial male phase.

In the last two size groups the true males continued to be present, and these are supposed to remain as males for the rest of their life. The last size group includes the adult *Teredo*. According to our observations the females are more numerous than males in this size group. Further observations are being made.

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## ON A NEW RECORD OF A BETHYLID PARASITE ON *RHIZOPERTHA DOMINICA*, FABR.

THE author came across a few Hymenopterons (Bethylidæ) in wheat infested by *Rhizopertha dominica*, Fabr.  As far as the writer is aware, there is no published record of any Bethylid parasite on *R. dominica*.  The adult female (Fig. 1) is black in colour and is very agile. It measures about  3·0 mm. × 0·5 mm.  The female is slightly bigger with a larger abdo-

men.  Under laboratory conditions a female which has copulated lives upto 8 days without any food, while the male lives upto 5 days without food, at an average maximum temperature of 93° F. and a minimum temperature of
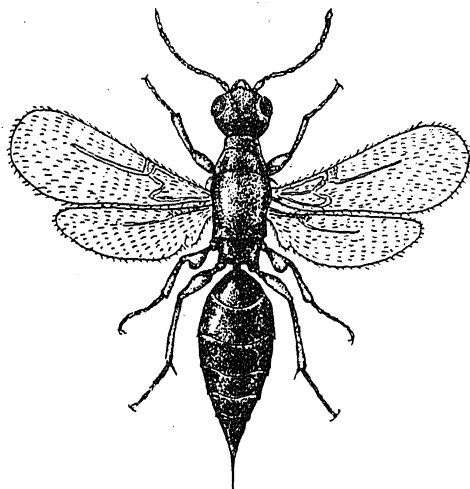


FIG. 1.  Bethylid parasite on *Rhizopertha dominica*, ×18.

80° F., and a mean relative humidity of 75 per cent., whereas the unmated male and a virgin female lived for 4 days and 7 days respectively under the above conditions. Preliminary studies on the effect of different sugars, *viz.*, glucose, fructose, raisin pulp and sucrose solution on the longevity of the adult parasite indicated that glucose served as the best food (survival value: 17 days).  The mating takes place within a day after emergence and lasts from half-a-minute to about one minute.  The females were found predominating in the cultures.  The first adult of the succeeding generation was observed after 13 days.  Further studies are being continued.

The writer is indebted to Dr. E. S. Narayanan for kind encouragement and facilities for the above studies.

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New Delhi, *December* 9, 1953.

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## INTER-GENERIC HYBRIDIZATION BETWEEN *BRASSICA* AND *RAPHANUS*

IN the course of *Raphano-Brassica* hybridisation during the last two years, attempted in different seasons when the plants were in flower, special efforts were made to cross *Brassica oleracea* (Cauli-flower), $(2n = 18)$ as female and *Raphanus sativus* (Radish), $(2n = 18)$ as male, as it had been reported by workers[2,4] that the cross did not succeed with *Brassica oleracea* as female. During the course of the present investigation it was observed that *Raphanus* female and *Brassica* male crosses were fairly successful, whereas the reciprocal cross did not succeed at all.

To examine the causes for the failure of the cross in the reverse direction, emasculated buds of each species (*Raphanus* BR.1 and *Brassica* BR.1) were pollinated with fresh functional pollen of the other species and were fixed in formol-acetic alcohol and carnoys solution for 24 hours, after varying intervals of pollination ranging from 6 hours to 96 hours. These pistils were dehydrated and infiltrated in a *n*-butyl alcohol series[5] and embedded. They were sectioned at $10\mu$. Sectioned as well as crushed pistils were stained in cotton blue. Pollen grains of both the species were cultured on sucrose-agar medium.[1,3]

It was found, both in sectioned as well as crushed pistils, that *Brassica* pollen germinated very freely after about 18 hours of pollination and also that fertilisation took place in about 36 hours of pollination. Germination of *Raphanus* pollen on *Brassica* stigma was very poor, and was calculated to be about 4 per cent., irrespective of the time-interval of pollination. These pollen grains, which had grown pollen tubes, were found to be on the stigmatic surface without any penetration into the *Brassica* styles. Scraping the stigmatic surface before pollinating the *Brassica* stigmas did not result either in any increase in the germinability of *Raphanus* pollen, or in the few pollen tubes growing down the *Brassica* stylar tissue. Pollen tube growth rate in separately cultured grains was almost similar in both the cases.

It may also be mentioned that the style measurements of the two species in question are the same. The style lengths of *Brassica* and *Raphanus* are 9·6-9·7 mm. and 9·5-9·8 mm. respectively. Thus, the failure of the cross in the reciprocal direction may be interpreted as due to the presence of some inhibiting factor or factors, the nature of which has to be determined and which act as a barrier to pollen tube growth in *Brassica* styles and its penetration into them—a phenomenon characteristic of speciation.

Agri. Res. Inst.,   K. N. SUBRAMANYAM.
Sabour (Bhagalpur),
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## BREEDING HABITS OF THE INDIAN SHEATH TAILED BAT *TAPHOZOUS LONGIMANUS* (HARDWICKE)

THE reproductive patterns of bats so far studied can be classified into the following categories :

(*i*) Copulation occurs in autumn and the spermatozoa hibernate inside the genital tract of the female throughout winter and fertilise the ova in the next spring as in *Vespertilio murinus, Rhinolophus ferrum equinum*,[9–11] the British horse-shoe bats[6] and *Myotis lucifugus lucifugus*.[12] (*ii*) Copulation normally occurs in autumn and the sperms are stored inside the genital tract of the female; but there may also occur copulation in winter and spring as in *Myotis lucifugus lucifugus*.[4] (*iii*) Copulation and fertilisation occur in autumn as in *Lyroderma lyra lyra*.[3] (*iv*) Copulation as a rule occurs in spring and is immediately followed by fertilisation and pregnancy as in *Nyctinomus cynocephala*,[5] *Miniopterus australis*[1] and *Scotophilus wroughtoni*.[2] In all the cases mentioned above, pregnancy occurs only once a year whatever the period of copulation be. Occurrence of more than one pregnancy in a year was recorded by Matthews[7,8] in *Nycteris luteola*, which becomes pregnant during lactation period. (*v*) There is no restricted breeding season but breeding occurs all the year round, and pregnancy occurs in the lactation period as in *Desmodus rotundus*.[13]

Collections of specimens of *Taphozous longimanus* were started in October 1947 and are still being continued. Specimens were collected round about Nagpur and Amaravati (India),

and collections were made practically in all the months of the year. The following table is included to give the data of collections so far made with details of information necessary for the present study :

TABLE I

| Month | Females | | | | Males | | |
| | Pregnant | Lactating | Non-Pregnant | Immature | Adults | Immature | Total |
|---|---|---|---|---|---|---|---|
| January | 3 | 2 | 1 | 1 | 3 | .. | 10 |
| February | 4 | 1 | 2 | 2 | 5 | .. | 14 |
| March | 8 | 3 | 1 | 1 | 3 | 1 | 17 |
| April | | No Collections | | | | | |
| May | | No Collections | | | | | |
| June | 3 | 3 | 1 | 2 | 1 | 1 | 11 |
| July | 1 | 1 | 3 | 1 | 2 | .. | 8 |
| August | 15 | 3 | .. | 2 | 2 | 1 | 23 |
| September | 11 | 8 | 1 | 5 | 12 | 2 | 39 |
| October | 12 | 8 | 3 | 2 | 4 | 2 | 31 |
| November | 4 | 4 | 4 | 2 | 3 | 2 | 19 |
| December | 2 | 4 | .. | 1 | 5 | 1 | 13 |
| Total | 62 | 38 | 16 | 19 | 40 | 10 | 185 |

*Note.*—The word 'immature' has been used in the above table to denote young specimens that were found attached to the nipples of the mothers when the mothers were shot.

On the basis of the study of the collected material the following observations have been made : (1) pregnant females were collected in all the months of the year; (2) in any one collection there were females carrying foetuses at different stages of development and also females at different stages of sexual activity as revealed by the microscopic examination of the sections of the ovaries; (3) lactating females were collected in all the months of the year; (4) 16 lactating females each carrying a young at the breast and collected during different months of the year showed, on dissection and sectioning, that pregnancy had again started in one of the horns of the uterus. In 8 of these specimens the ovary on the non-pregnant side showed a distinct scar indicative of the *corpus luteum* of the previous pregnancy; (5) males in full spermatogenetic activity were collected in all the months of the year.

*Taphozous longimanus* thus resembles *Desmodus rotundus*[13] in its breeding behaviour. There is no restricted breeding season, but breeding occurs throughout the year. Further, these bats experience pregnancies in quick succession as pregnancy starts even before the lactation period is over, and in such cases,

pregnancies alternate between the two horns of the uterus.

Two interesting facts may, however, be mentioned—that *Lyroderma lyra lyra*,[3] which is also found in the same locality, has a sharply restricted breeding season; and secondly, that from the point of view of climatic conditions, Nagpur experiences sharply defined seasons, winter being fairly cold and summer being very hot and the rainy season being restricted to June, July, August and September. These points are mentioned here because two species of bats inhabiting the same locality have very different sexual rhythms.

Full details of sex-cycle in *Taphozous longimanus* are being worked out and will be reported soon.

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College of Science,
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## A REINVESTIGATION OF THE EMBRYOGENY OF *ISOMERIS ARBOREA* NUTT

IN a paper entitled "Some New Features in the Reproductive Cytology of Angiosperms, illustrated by *Isomeris arborea*" Billings[1] reported many interesting features in this plant : (1) the megaspore mother cell directly gives rise to the embryo-sac ; (2) the mature embryo-sac is 3-nucleate ; (3) fertilization is absent ; (4) the endosperm shows peculiar multinucleate nodules ; and (5) the embryo arises from one of the endosperm nodules.

In a reinvestigation Maheshwari and Khan[2] have shown that the megaspore mother cell undergoes the usual reduction divisions and the mature embryo-sac is monosporic and 8-nucleate. They confirm the occurrence of endosperm nodules but leave the origin of the embryo as an open question to be decided by further study.

*Letters to the Editor*

Recently we obtained some critical stages refuting Billings' theory of the endospermic origin of the embryo. In all early stages the embryo is seen in the normal zygotic position and a comparison of the stages shown in Figs. 1-7 leaves no doubt that the embryo arises from the egg. Billings' statement that "no true egg is formed" is contradicted by our Fig. 1.

the embryo-sac. He adds, however, that "this activity seems to serve no important useful purpose". Here again our finding is that the synergids are ephemeral and inactive (Fig. 1) and the cell row is a product of divisions of the egg.

The most important point which Billings tried to make out is that the embryo arises from an
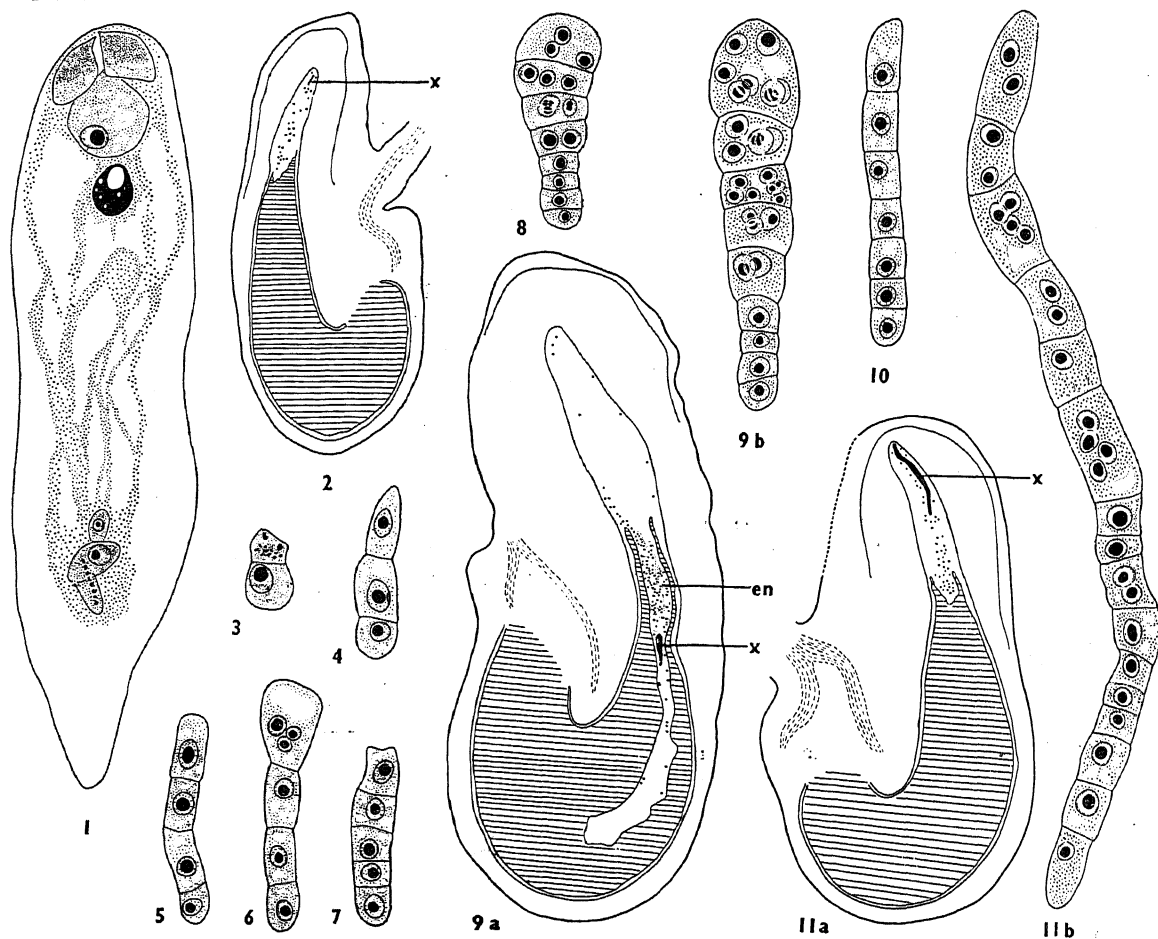


FIG. 1. Mature embryo-sac, × 383.

FIG. 2. L.s. ovule showing position of proembryo (marked x) during early stages. The dots in the embryo-sac represent endosperm nuclei, while the nucellar tissue is indicated by horizontal lines, × 37.

FIGS. 3-7, 10. Proembryos at different stages of development; all have arisen in the position marked x in Fig. 2, × 383.

FIG. 8. Proembryo with multinucleate suspensor cells. This was found considerably below the micropylar end, × 383.

FIG. 9a. L.s. ovule showing endosperm nodules (*en*). in the middle part of the embryo-sac; the proembryo is marked x, × 37.

FIG. 9b. More highly magnified view of proembryo of Fig. 9a, × 383.

FIG. 11a. L.s. ovule showing long filamentous proembryo at x, × 37.

FIG. 11b. More highly magnified view of proembryo marked x in Fig. 11a; most of the basal cells of the proembryo are multinucleate, × 383.

Billings states that occasionally a synergid becomes richly protoplasmic and forms a cell row extending down from the micropylar end of

endosperm nodule. He writes: "A search for young embryos in ovules with only a moderate amount of endosperm has always yielded

negative results. Only after the ovule has reached a comparatively large size, and nodule formation has about reached completion has the presence of an embryo been noted." Since there is no established case of a similar nature known in any angiosperm, we paid special attention to this point and can state definitely that while older embryos are found considerably below the micropylar end of the embryo-sac, this is certainly not the case in early stages. Proembryos of the type shown in Figs. 3-7 and 10 arise in the position marked x in Fig. 2 long before there is any trace of endosperm nodules. They originate mostly by transverse divisions and often form a long uniseriate row of cells of which a few lying towards the micropylar end become multi-nucleate (Figs. 11 *a*, 11 *b*). The different position of other proembryos is a derived state caused at least partly by the extension of the micropylar end of the embryo-sac which continues to grow leaving the embryo behind (Fig. 9).

If the embryo were really to arise from an endosperm nodule, polyembryony should have been a common occurrence in *Isomeris,* for all the nodules are more or less alike and should have a similar potentiality. Since Billings never found more than one proembryo in an ovule (we are able to confirm this), it is surprising why he did not consider this point as a possible objection to his interpretation.

It is concluded that there are no exceptional features in the embryology of *Isomeris* excepting a somewhat abnormal position of the embryo and the presence of endosperm nodules which are quite prominent as well as numerous and are seen to differentiate soon after the initial wave of free nuclear divisions is over. Endosperm nodules, however, occur in a few other plants also, *viz., Musa errans,*[3] *Impatiens roylei,*[4] *Stackhousia liniariefolia,*[5] *Capsella bursa pastoris,*[6] *Oldenlandia corymbosa,*[7] and it is possible that they will be discovered in many other angiosperms.

Grateful thanks are due to Dr. Elizabeth McClintock (San Francisco), Dr. M. A. Myers (San Diego State College, California), Dr. Verne Grant (Claremont, California) and Dr. E. Y. Dawson (Los Angeles, California) who very kindly provided the material on which this study is based and to the Indian Council of Agricultural Research for a research grant in connection with a scheme on "Chemical Stimulation of the Ovule". The work on *Isomeris* was undertaken in the hope that if the embryo does arise from an endosperm nodule it should

be possible, by suitable chemical treatment, to stimulate several nodules to develop into embryos. This hope was based on the findings of Billings which have now been shown to be incorrect.

Dept. of Botany,          P. Maheshwari.
University of Delhi,       R. C. Sachar.
Delhi-8, *January* 8, 1954.

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2. Maheshwari, P. and Khan, R., *Phytomorphology*, 1953, **3**, 446.
3. Juliano, J. B. and Alcala, P. E., *Philippine Agr.*, 1933, **22**, 91.
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7. Farooq, M., *Curr. Sci.*, 1953, **22**, 280.

## OCCURRENCE OF THE GROUND SHARK *CARCHARHINUS GANGETICUS* (M.H.) IN THE RIVER MAHANADI

*Carcharhinus gangeticus* (M.H.) has not so far been caught from Orissa rivers. Day[1] makes specific mention that this shark is common in the seas of India, ascending rivers far above the tidal influence. The bulletin[2] 'Preliminary Guide to Indian Fish, Fisheries, Methods of Fishing and Curing' notes that the Ground Shark of the rivers is very common in the Bay of Bengal. The Fisheries Department of the Government of Orissa has been extracting shark liver oil from these unwanted variety during the last six years. The production of fish-meal from the flesh has started since three years. However, so far as we are aware, this is the first time that these sharks have been caught by fishermen at the Zobra-Barrage of the River Mahanadi. The distance of the Barrage from the mouth of the river is about 60 miles. Usually the sharks are caught from the different centres situated along the sea coasts, the Chilka Lake and the mouths of the larger rivers.

The Zobra fishermen caught these fishes from the last week of July 1953. The bait used are usually small-sized *Hilsa ilisha* (Ham.), *Wallago attu* (Bloch) and *Mystus aor* (Ham.) ranging from 6″ to 2′. The bait is entangled to a large iron hook and attached to a long chord, commonly known as 'Suti'. This shark is known in Oriya as 'Mundah Magara' or sometimes 'Magara'.

Table I shows the dates of catch, total length, furcal length, yield of liver oil and fish-meal. It is observed that the yield of liver oil and

fishmeal do not depend on the length of the shark. It may be noted here that these fishes were caught during the new moon and full moon dates and that all the specimens were male. The flood level of the river was quite high.

TABLE I

| Date of catch | Total length | Furcal length | Weight (lb.) | Liver oil (lb.) | Fishmeal. (lb.) |
|---|---|---|---|---|---|
| 31—7—53 | 7' $\frac{1}{2}$"* | 6' 1" | 121 | .. | .. |
| 3—8—53 | 6' 10$\frac{1}{2}$" | 5' 11" | .. | 3 | 10 |
| 29—9—53 | 6' 1" | 5' 2" | .. | 8 | 8 |
| 30—9—53 | 6' 6$\frac{1}{2}$" | 5' 6$\frac{1}{2}$" | 114 | 4$\frac{1}{2}$ | 6 |
| 1—10—53 | 6' 5" | 5' 5$\frac{1}{4}$" | 115 | 3 | 7 |

\* Given to the Hospital.

Besides the five specimens brought to our technological laboratory, we were not able to study three other fishes which were sold at the local market.

We are indebted to Sri. G. N. Mitra and Sri. G. B. Mohanty for their interest and suggestions.

Dept. of Fisheries,          P. MOHAPATRA.
Cuttack,                     A. B. ROY.
*November* 14, 1953.         B. NAYAK.

1. Day, F., *Fishes of India* (London, 1889).
2. Marketing Series No. 24, Government of India, 1941.

## CHROMOSOME NUMBERS OF SOME INDIAN ECONOMIC PLANTS

THREE lists of chromosome numbers of plants native to and introduced into India and now forming part of the Flora of India were published.[1-4] A further list is now given below. In the case of *Monstera deliciosa*, Janaki Ammal[5] has recorded a number $2n = 24$. A sample of sorghum received in 1937 by the Millets Specialist, Coimbatore, from R. E. Karper, Vice-Director, Texas Agricultural Experiment Station, Texas, U.S.A., labelled as Tunis grass with multiflorus spikelets has been found to have intermediate characters between *S. halepense* and *S. sudanense*. Tunis grass is *S. virgatum*.[6] The characteristics of this sample is unlike *S. virgatum*. *Pennisetum subangustum* was received from the West African Inter-Territorial Secretariat, Accra, Gold Coast.

| Species | $n$ | $2n$ | Remarks |
|---|---|---|---|
| GUTTIFERÆ | | | |
| *Garcenia tinctoria.* Dunn. | | c.80 | Fruit Research Station, Kallar, Nilgiris |
| *Garcenia Cambogia,* Desr. | | c.58 | do.    do. |
| AMPELLIDACEÆ | | | |
| *Vitis vinifera*, L. Green grape (Krishnagiri type) | | 38 | Local garden, Coimbatore |
| *Vitis vinifera*, L. Blue grapes | | 38 | do.    do. |
| *Vitis vinifera* Kishmish (seedless) | | 38 | do.    do. |
| *Tetrastigma sulcatum* Gamble. | | 22 | Top-slip Anamalais, 2,400 ft. |
| *T. lanceolarium* Planch. | | 44 | do. & Rangaswami Hills |
| *Cissus pallida* Planch. | | 26 | Anamalais, 2,500 ft. |
| *C. Heyneana* Planch. | | 28 | do.    do. |
| *C. glauca* Roxb. | | 24 | do. & Marudamalai, 3,000 ft. |
| *C. discolor* Blume. | | 24 | do.    do. |
| SOLANACEÆ | | | |
| *Solanum pubescens,* Willd. | | 24 | Bhavanisagar, Coimbatore |
| ARACEÆ | | | |
| *Monstera deliciosa,* Liemb. | | 48 | F. R. S. Kallar, Nilgiris |
| GRAMINEÆ | | | |
| *Sorghum virgatum?* | 10 | 20 | U. S. A. Texas Exp. Stn. |
| *Rottboellia exaltata,* Linn. | 18 | | Weed, Coimbatore |
| *Setaria palmifolia,* Stapf. | 27 | 54 | Rain forests and Hills, 3,000 & above |
| *Pennisetum subangustum,* S. & H. | 18 | | Gambia, West Africa |
| *Oryza granulata,* Nees & Arn. | 12 | 24 | Anamalai Hills, 2,500 ft. |
| *O. breviligulata,* A. Chevaliar & Roehrich | | 24 | French Sudan, Africa |
| *O. brachyantha,* A. Chevalier & Roehrich | | 24 | do.    do. |

The numbers in *Vitis vinifera* conform to those already recorded for other cultivated varieties of grapes.[5] In the genus *Cissus* apart from the aneuploid series certain peculiarities are also noted in the chromosomes. The genus *Garcenia* presents high numbers with small chromosomes. *G. tinctoria* probably has numbers nearer to *G. mangostana* while *G. cambogia* is closer to *G. indica* or *G. speciosa*.[2] *Pennisetum subangustum* is a tetraploid species of the section *Eu-pennisetum*. More detailed

work is being done on these species and the results will be published elsewhere.

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Agric. Res. Inst.,           V. S. RAMAN.
Coimbatore,                  B. V. SHETTY.
*October* 31, 1953.          P. CHANDRASEKHARAN.

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5. Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945, Allen and Unwin, Ltd., London.
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## NUCLEATED VESSEL ELEMENTS IN TENDRILS OF *VITIS REPENS*, W. & A.

IT is usually stated that vessel elements or members are non-living cells. Esau[1] says: "In the mature state, tracheids and vessel members are more or less elongated cells with lignified secondary walls and devoid of protoplast". Later, she writes (p. 225) that after the formation and lignification of the secondary walls, "the swollen parts of the primary wall break down, and finally the protoplasts die and disappear". In other words, the disappearance and loss of the protoplast usually synchronizes with the formation of perforation plates (Eames and MacDaniels,[2] Fig. 49; Esau,[1] Figs. 11-13).

While examining macerations of the tendrils of *Vitis repens* growing at Surat, some mature vessel elements of secondary xylem were found to contain a nucleus and cytoplasm (Figs. 1, 2 *a* and 2 *b*). The vessel elements are fairly elongated cells with lignified cell-walls, scalariform perforations and simple pits on the lateral walls. Among the nucleated vessel elements, some showed a small amount of weakly staining cytoplasm and nucleus (Fig. 1), while others showed more prominent cytoplasm extending about half the length of the vessel element (Figs. 2 *a* and 2 *b*). The cytoplasm appeared vacuolated and granular, and the nucleus, which is more or less rounded with a single nucleolus, was embedded in the cytoplasm.

The presence of a nucleus and cytoplasm in mature vessel elements is rather remarkable. The number of vessels in a tendril is very small as the secondary xylem consists mostly of fiber-tracheids, both septate and non-septate. Some of these too showed the presence of protoplasts (Figs. 3, 4 and 5).
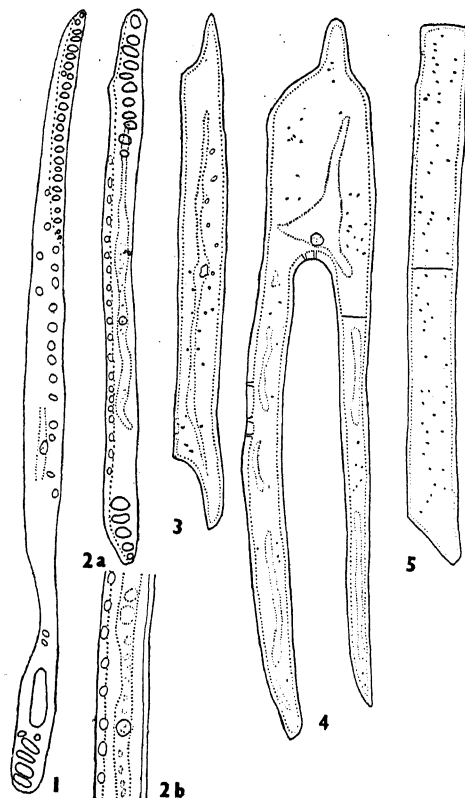


FIG. 1. A vessel element with scalariform perforation showing scanty cytoplasm and nucleus, × 220.

FIG. 2*a*. A vessel element showing vacuolated cytoplasm and nucleus × 300.

*b*. Part of the Fig. 2*A* showing the nucleus and cytoplasm, × 500.

FIG. 3. Fiber tracheid with nucleus and protoplast × 300.

FIG. 4. Septate fiber tracheid of peculiar shape containing cytoplasm and nucleus, × 220.

FIG. 5. Septate fiber tracheid devoid of cytoplasm, × 220.

Biology Dept.,                    J. J. SHAH.
M. T. B. College, Surat,
*November* 16, 1953.

1. Esau, K., *Plant Anatomy*, 1953, 1st Ed., New York, Wiley.
2. Eames and 'MacDaniels, *An Introduction to Plant Anatomy*, 1947, 2nd Ed., McGraw-Hill, New York.

## CHEMICAL EXAMINATION OF THE BARK OF *TABERNAEMONTANA DICHOTOMA*, ROXB.

FROM the bark of *Tabernœmontana coronaria* Br., Ratnagiriswaran and Venkatachalam[1] reported the isolation of two cardiac active alkaloids, tabernæmontanine, $C_{20}H_{26}O_3N_2$, m.p. 208-10° C., and coronarine $C_{44}H_{56}O_6N_4$, 2·5 $H_2O$, m.p. 196-98° C. (dec.) in a very low yield, and from the unsaponifiable matter a crystalline 'resin-alcohol', $C_{17}H_{32}O_4$, m.p. 180-81° C. Later, Warsi and Ahmed[2] reported that from *T. coronaria,* they isolated the alkaloid tabernæmontanine, m.p. 217-18° C. (dec.) and the 'resin alcohol', m.p. 185-87° C. More recently Kartha and Menon[3] working on the root bark of *T. crispa* (dichotoma) have mentioned that the alkaloid could not be obtained in a pure state but the neutral fraction from the alcoholic extract of the bark yielded a crystalline substance, $C_{12}H_{20}O$, m.p. 192-94° C.

The present communication records the results of a preliminary chemical examination of the bark from the stem and root of *T. dichotoma.* The powdered bark (2 kg.) was percolated with alcohol and from the concentrate obtained after removal of solvent under reduced pressure below 50° C., the alkaloids were extracted with dilute mineral acid. The non-basic residue was freed of fatty matter by refluxing with alcoholic potassium hydroxide and the unsaponifiable fraction separated by usual methods yielded after repeated crystallisation from alcohol, a crystalline substance (3 g.), m.p. 149-52° C. After chromatographic purification on a column of neutral alumina, the material was recrystallised from alcohol and fine clusters of colourless needles (2·5 g.; m.p. 154-56° C.) were obtained. A small quantity (0·05 g.) of another colourless crystalline substance, m.p. 163-64° C., was also obtained from the alcoholic solution.

With acetic anhydride and concentrated sulphuric acid and also in the Liebermann-Burchard reaction, the crystalline compound, m.p. 154-56° C., gave a pink colour. In the Salkowski reaction the chloroform layer had a greenish tinge and the sulphuric acid layer turned from faint yellowish red to orange in colour.

On the basis of analytical data the crystalline compound m.p. 154-56° C., which showed $[\alpha]_D^{29°} = +65, 67\cdot5$ (1 per cent. solution in absolute alcohol) has been assigned the provisional molecular formula $C_{28}H_{48}O$. (Found: C, 84·13; H, 11·93 per cent. and M.W. (Rast) 406·6; $C_{28}H_{48}O$ requires: C, 83·99; H, 11·99 per cent. and M.W., 400). The acetate prepared by treatment with acetic anhydride and fused sodium acetate, was obtained as colourless needles from alcohol, m.p. 164-67° C., $[\alpha]_D^{29°} = +70\cdot2$ (alcohol). (Found: C, 81·55; H, 11·88; $C_{30}H_{50}O_2$ requires: C, 81·45 and H, 11·31 per cent.). The benzoate was prepared by the action of benzoyl chloride in pyridin medium. It crystallised from ethyl acetate in colourless needles, m.p. 234-35° C. (Found: C, 83·2; H, 10·1; $C_{35}H_{52}O_2$ requires: C, 83·33 and H, 10·31 per cent.).

The alkaloidal content of the bark was too low (yield 0·01 per cent.). A colourless crystalline base, soluble in ether and non-phenolic in character, m.p. > 360° C. was obtained in traces from the total alkaloid. However, further work on the alkaloidal constituents had to be postponed for want of sufficient material. A preliminary investigation of the bark of *T. heyneana,* another closely related plant of the same genus, has also been carried out in this Laboratory and the results will be reported soon.

A. V. SUBBARATNAM.

National Chem. Lab. of India,
Poona-8, *September* 30, 1953.

1. Ratnagiriswaran and Venkatachalam, *Quart. J. Pharm. Pharmacol.,* 1939, **12**, 174.

2. Warsi and Ahmed, *Pakistan J. Sci.,* 1949, **1**, 128. and *C. A.,* **45**, 4889[h].

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# REVIEWS

**Text-Book of Optics.** Second Edition. By N. K. Sethi and S. B. Raizada. (Premier Publishing Co., Delhi), 1953. Pp. 436. Price Rs. 10.

**Text-Book of Sound.** By Singh and Prakash. (Krishna Publishing House, Kanpur), 1952. Pp. viii + 319. Price Rs. 7-8-0.

The above text-books are designed primarily to meet the needs of the student studying for the B.Sc. Pass Course in our Universities and constitute a welcome addition to those already available in the field.

The text-book on optics by Sethi and Raizada is divided into three parts. The principles of geometrical optics are dealt with in the course of 7 chapters and constitute the first part of the book. Part II is devoted to the treatment of the principles of physical optics in 10 chapters, the emphasis being laid throughout on fundamentals rather than on details. There is also a brief introduction to quantum theory of atomic spectra in the chapter concluding this part. Optical instruments and measurements take up the remaining 8 chapters of the book, designated as Part III.

The text-book on sound by Singh and Prakash follows the usual lines, although in view of the free use of the calculus and the fairly thorough treatment of the mathematical theory of sound, there is some justification for the authors' claim that the book, while fully catering to the needs of the B.Sc. Pass Course, may also serve as an introduction to those studying for the Honours Degree. The chapters on subjective effects of sound, the ear, audition, speech and musical scale, acoustics of buildings and ultrasonics certainly cover much useful ground outside the University syllabus. Questions and numerical problems form a useful appendix to each chapter.

While Indian authors are doing their best to produce text-books of quality, it is a pity that the get-up of most of these fall far short of what one has a right to expect, even under present conditions. Foreign publishers like McGraw-Hill, Academic Press, Inc., and the like, have set up a standard in the matter of the choice of the quality of paper, illustrations, typeset, index and presentation, especially of the cover and title pages, which it would be well for science publishers in India to be familiar with, if not also to emulate. It is to be hoped that this important aspect of the text-book, technical excellence in get-up and pro-duction, will be insisted on even more by the authors themselves than by the young and the innocent public who patronise them.

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**The Proteins, Chemistry, Biological Activity and Methods.** Edited by H. Neurath and K. Bailey (Published by Academic Press, Inc., New York), 1953. Vol. I, Part A, Pp. viii + 548; Part B, Pp. viii + 549-1,115. Price: Vol. I, $ 12.00; Vol. II, $ 13.00.

The object of this treatise is to present a comprehensive, integrated account of the chemical, physical and biological properties of proteins. The appearance of such a treatise is very timely, for many diverse methods have been developed in recent years for the study of the ultimate chemical structure of proteins and for the correlation of this with biological activity, and the task of keeping in touch with all these by reference to original literature is practically impossible. In this volume, the different aspects have been well covered by a collaborative effort, each topic being discussed by a specialist, particularly familiar with the techniques and results in his field.

The first three chapters are purely chemical, dealing respectively with isolation of proteins (J. F. Taylor), chemistry of amino acids and peptides (P. Desnuelle) and amino acid composition of proteins (G. R. Tristram). Next follow two chapters on physical methods for the study of their structure, namely, by means of X-ray diffraction (B. W. Low) and optical behaviour (P. Doty and E. P. Geiduschek). The last chapter of Part A is concerned with the electrochemical properties of proteins and amino acids (R. A. Alberty).

Part B also deals with diverse topics, although the bulk of it is devoted to the chemical interactions and modifications produced by external agents. Chapter VII by J. T. Edsall deals with the results obtained by various physical methods on the size, shape and hydration of protein molecules. The next chapter by I. M. Klotz is concerned with the interactions of proteins with ions and the methods available for investigating these and their significance in biology. Protein denaturation and the modifications produced in proteins by chemical treatment are discussed in two chapters by F. W. Putnam. The concluding chapter is by R. R. Porter on the relation between chemical structure and biological activity.

In spite of the heterogeneous treatment, the editors have done an excellent job in placing the various articles together and there is very little of overlap. There is no doubt that "Neurath-Bailey" will be the standard reference book on the subject for some time to come.

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Standard Methods of Clinical Chemistry. Vol. I. By the American Association of Clinical Chemists. (Editor-in-Chief : Miriam Reiner.) (Published by the Academic Press, Inc., New York, N.Y.), 1953.

The volume under review which is the first in the series is expected to serve biochemists engaged in clinical laboratories to aid physicians in clinical diagnosis. Laboratory aids to clinical diagnosis are necessarily on the increase and of these a biochemical laboratory plays an integral role. Tests carried out in such laboratories are sometimes cumbersome and time-consuming. This book aims at simplifying and standardising some of the more common tests for facilitating quick yet accurate results.

The American Association of Clinical Chemists with experience in this line have the necessary authority therefore to lay the respective tests for acceptance. Each method is said to be performed in the laboratory of the "submitter" and passed on to another named the "checker" who, after verifying, submits the report combining criticism and suggestions for further perfection.

The tests are arranged in this book (as far as we could see) in alphabetical order beginning with amylase, biluribin, calcium and ending up with thymol turbidity, urea nitrogen and uric acid. The biochemist in performing these tests is also expected not only to report but integrate the results with clinical findings, with full knowledge of the limitations of the methods and their significance.

The book is also intended to help technicians in a biochemical laboratory as also junior medical men for collecting, preserving and submitting specimens to the laboratory. This information, to our mind is vital, as careless and mechanical collection and transference of specimens from the bedside to the laboratory has often vitiated results or embarrassed the laboratory biochemist.

We look forward to subsequent volumes in the series and fully trust that the present simplified manual will be of value to the laboratory biochemist in his great task of assisting the clinician to arrive at diagnosis.

V. Iswariah.

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British Standard for Recommended Common Names for Pest Control Products. B.S. 1831, Part II. (Issued by British Standards Institution, Sales Branch, 2, Park Street, London, W. 1), 1953. Price 2 *sh.* net.

The British Standards Institution has just issued Part II of B.S. 1831 which consists of six common names for pure pest control chemicals well known in agriculture ; Part I was published in 1952 and further lists will be published from time to time.

Of these six names allethrin and methoxychlor are already accepted as coined common names by the United States Interdepartmental Committee on Pest Control. In both the U.K. and the U.S.A. the names have been pre-empted as far as possible for common use, by recording them with H.M. Patent Office and the U.S. Patent Office, respectively.

The common name is assigned to the 100 per cent. pure chemical and is correlated with the chemical name and the formula. Where more than one chemical name is known for that material, the first which is given is in accordance with the principle recommended by the Chemical Society of London. The common names and chemical names are indexed for convenient reference and this index may afford guidance to those concerned with indexing and abstracting, as to the preferred alphabetical arrangement of these names. The numbering of the common names is a continuation of that adopted in Part I.

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Bibliography on the Genetics of Drosophila. Part II. By Irwin H. Herskowitz. (Bibliography No. 6 of the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh). Price 21 *sh.*

This bibliography lists the publications on the genetics of Drosophila (the guinea-pig of geneticists) from 1939 to 1950 and supplements the previous one of Prof. H. J. Muller. 2,824 publications (and not 2,841 as stated in the Introduction), are listed, authorwise. Some publications closely connected with Drosophila work are also listed. A useful innovation over Muller's Bibliography is the general title index and a systematic index classifying the work on 65 species of Drosophila.

There is no need to stress the importance of this publication for those interested in Drosophila genetics. It is also of value to all students of genetics, as the study of this genus of fruit flies has contributed greatly to that science. This bibliography may be considered essential to all research workers in genetics. Professor

Muller in his preface has pointed out, "The further the Drosophila researches have gone, the larger has been the number, and greater the importance of both the intellectual and biological tools available of pressing the investigations on this same material to even wider horizons and deeper levels." It is interesting to learn that there has been an increase in the rate of publications on Drosophila, in spite of war, post-war conditions, and suppression by political intervention.

B. MISRO.

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**Sand and Water Culture Methods Used in the Study of Plant Nutrition.** By E. J. Hewitt. (Technical Communication No. 22, Commonwealth Agricultural Bureau, Farnham Royal, England), 1952. Pp. x + 241. Price 42 *sh.*

Plant life, unlike animal life, performs certain life functions that demand a very intimate knowledge of what forms of nutrition stimulate these constructive processes within the chlorophyll-bearing cells during photosynthesis. The discovery of the role of heavy metals or micronutrients in the physiological functions of plant cells has been one of major importance to horticulture and has not only stimulated fundamental and applied sand culture experimentation but also extended its scope of enquiry to the chlorophyll-less group, the fungi. Indeed, in recent years, great volume of work has been done on fungal physiological problems using heavy metals and bioassay methods have been developed as a consequence of these researches culminating in the use of common organisms like *Aspergillus niger,* under highly controlled conditions, to detect minute traces of molybdenum, copper, manganese, etc., in a mobile form at concentrations less than 0·25 gamma. This being so, the need for an authoritative book on the technique developed in recent years in the study of sand and water culture methods in plant nutrition has been there for some time and the book under review admirably fulfils the lacuna. In fact, the significance of micronutrients in plant growth and plant well-being is not to be, for long, the main importance as, indeed, plant pathologists are increasingly aware of the interactions of these heavy metals in many *in vivo* toxemia of plants and also in the puzzling question of virus multiplication in plant tissues.

The book is presented in two parts. The first summarises many of the minute details of the techniques used in the field of plant physiology, *viz.,* container and their composition, rooting media, base exchange materials, quality of water, methods of purifying nutrient reagents, osmotic pressure and salt tolerances, sources of nitrogen, pH, aeration, design of experiments, etc. The second summarises special techniques developed by the author and his collaborators for large-scale pot-sand cultures. The author has undertaken a difficult task in getting together tables and text-figures from many published and unpublished sources to make a very well integrated story and deserves all praise for it. The bibliography is exhaustive and the general get-up is good. It should be mentioned that the book is largely one on techniques and should be found most useful by all those undertaking micronutrient investigations with plants and also by general agronomists and horticulturists who are unaware of the great strides made in making the subject precise and scientific. These workers should, in the fitness of things, keep abreast with all the latest developments in a branch of plant physiology which has come to be regarded as a vital key to a greater understanding of plant behaviour in their soil environment, be it vegetable, fruit, cereal or micro-organism culture.

T. S. SADASIVAN.

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**Mr. Tompkins Learns the Facts of Life.** By G. Gamow (Cambridge University Press), 1953. Pp. xi + 88. Price 12 *sh.* 6 *d.*

It was a delightful idea of Professor Gamow to have presented us with another instalment of the adventures of Mr. Tompkins, not among quanta and atoms this time, but in the regions of the stuff that he is made of.

As in the previous volume, there are three dreams and a lecture by the Professor. In the first dream, "Through the blood-stream", Mr. Tompkins finds himself injected into his own body and travels extensively through his tissues, meeting erythrocytes, phagocytes, bacteria, anti-bodies, hormones and vitamins, and suddenly wakes up suffering from an attack "by a flock of hungry trypsins, amylases and lipases". The second dream, "Gene's Piece of Mind" introduces Mr. Tompkins to chromosomes and genes, and the processes of cell division and growth. The third dream on "Brainy Stuff" is by far the most entertaining. Mr. Tompkins meets the calculating machine, "The Maniac" and has an interesting discussion with him, learning much about the way the brain functions.

One cannot but admire the lucidity with which the author writes and more so, the aptness of his examples and the fine sense of humour that pervades the whole book. For

instance, regarding Lysenko's theory, Mr. Tompkins is told, "Western geneticists do not take it seriously, but as a matter of fact, there are many cases in which Lysenko is undoubtedly right. Thus, for example, if Mrs. P gives birth to a baby who looks like her husband, Mr. P, we speak about gene-heredity. But if Mrs. P's baby looks more like Mr. S, a neighbour next door, the effect must be certainly ascribed to the environment."

We do hope that Mr. Tompkins is not too tired and that he would set out very soon on another of his trips, may we suggest, through the maze of the *psyche* and all that it stands for.

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Selected Chapters from Modern Inorganic Chemistry. ·Second Edition. By K. K. Dole. (Dastane Brothers' Home Service, Ltd., Poona), 1953. Price Rs. 13-12-0.

The title of the book does not convey an accurate idea of the scope of the contents. The topics chosen are obviously intended to cater to the needs of students appearing in examinations up to B.Sc. Hons. or M.Sc. (Previous) standard in General Chemistry, but not in specialised Inorganic Chemistry. In a book produced in April 1953 ("revised and enlarged") one would expect up-to-date information and deletion of obsolete "chemical facts". This however is not the case. For example, the compounds of argon and boron fluoride mentioned on page 79 are not now accepted as "chemical facts" after the work of Wiberg and Karbe (1948). On the other hand, no mention is made of "clathrate compounds" discovered by Powell (1948). The chemistry of selenium and tellurium (pp. 531-38), as treated in this book, is very meagre. That interesting compound telluric acid is not even mentioned, much less discussed with reference to its constitution. The treatment of transuranic elements in general, and of neptunium and plutonium in particular, gives the impression that they occur and are available like any other ordinary metal; their chemistry is discussed and even the metallurgy, without mentioning how these remarkable elements are produced (p. 481). Similarly, the method of thermal analysis in the investigation of alloys and intermetallic compounds discussed in pp. 560-61 does not bear critical examination. The curve in Fig. 26 has a second inflexion due to the separation of the eutectic, which is not clarified. The relation between Figs. 26 and 27 has also not been brought out. The discussion of the Periodic Table could have been cut down to the minimum on the

historical side and the space so saved utilised for a more modern treatment. In this chapter a number of modified tables have been reproduced with however one significant omission, that is, Bohr's modification. To the author the position of hydrogen is still a puzzle : "Many questions in regard to the Periodic Table are still without a final answer and two of these are, (1) the position of hydrogen, and (2) the distribution of the rare-earths of both the Lanthanide and the Actinide series. One has to wait and see how these are tackled and finally solved" (p. 51). One thought that these very questions had been satisfactorily solved in Bohr's Table.

The reference to the National Electrochemical Institute at Karaikudi in the body of the text on p. 434 reveals a lack of sense of proportion especially after its more prominent mention in the preface. Similarly there is an uncritical statement regarding the discovery of atomic nitrogen (p. 130) for which the authority should have been quoted, say, in a foot-note.

There is no purpose served by further critically examining each chapter. The aim of the author being to supply "tabloid" answers for certain specified types of questions, one can obtain only a superficial knowledge of the subject by reading this book. The topics chosen however, are those frequently found in examination papers, and to that extent the book may be useful and even popular; but it requires a good amount of supplementing and corrective reading.

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Organic Analysis. Vol. I. Edited by J. Mitchell, Jr., I. M. Kolthoff, E. S. Proskaner and A. Weissberger. (Interscience Publishers.) Pp. Pp. viii + 473. Price $ 8.50.

The volume under review is the first to be published in a series designed to deal with organic quantitative group analysis. It presents methods for the chemical determinations of hydroxy, alkoxy, $a$-epoxy, active hydrogen, carbonyl, acetal and organic sulphur groups and spectroscopic functional group analysis in the petroleum industry. Other group determinations and other branches of organic group analysis are to be considered in subsequent volumes.

The book is comprehensive in nature and each chapter is written by a worker who has himself contributed to the development of the particular field under discussion. The various chapters deal mainly with chemical methods of determination, though mention is made of instrumental and chromatographic methods, where available. A

critical evaluation of all available methods has been made and the methods which have been recommended are given in detail. Sources of error are referred to and ways to minimise or eliminate them described. Details for the preparation and standardisation, when required, of different solutions are given together with the necessary instructions for storing and handling them.

The book is well documented with references to the original literature upto 1952 and should serve as an excellent source of information in the field of organic group determinations.

S. SWAMINATHAN.

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## Books Received

*Inorganic Synthesis,* Vol. IV. Edited by John C. Bailar, Jr. (McGraw-Hill Book Co.), 1953. Pp. xii + 218. Price $ 5.00.

*Radio Receiver Design,* Part I. Second Edition. By K. R. Sturley. (Chapman & Hall), 1953. Pp. xx + 667. Price 56 *sh.*

*Structure Reports,* Vol. X. By A. J. C. Wilson. (A. Oosthoek Publishing Co., Utrecht, Holland), 1953. Pp. viii + 325. Price D. fl. 45.

*Fiber Microscopy.* By A. N. J. Heyn. (Interscience Publishers, Inc.), 1954. Pp. xiii + 407. Price $ 5.50.

*High Altitude Rocket Research.* By H. E. Newell, Jr. (Academic Press, Inc.), 1953. Pp. xiv + 298. Price $ 7.50.

*Union Catalogue of Learned Periodical Publications in South Asia Physical and Biological Sciences.* (Indian Library Association). (G. Glunt & Sons), 1953. Pp. 390. Price Rs. 25.

*Low Frequency Amplification.* By N. A. J. Voorhoeve. (Philips' Technical Library), 1953. Pp. xv + 495. [Available from Philips Electrical Co. (India), Ltd., Calcutta-20.] Price 24 *sh.* 4 *d.*

*Select Methods of Metallurgical Analysis.* Second Edition. By W. A. Naish, J. E. Clennel and V. S. Kingswood. (Chapman & Hall), 1953. Pp. xii + 660. Price 75 *sh.* net.

*A Systematic Catalogue of the Main Identified Entomological Collection at the Forest Research Institute,* Dehra Dun. Indian Forest Leaflet No. 121 (Part III). Publishd by the Manager of Publications. Pp. 39-187. Price Rs. 4.

*Chromatography.* By Edgar Lederer and Michael Lederer. (Elsevier Publishing Co.), 1953. Pp. xviii + 460. Price 60 *sh.*

*Neutron Optics.* By D. J. Hughes. (Interscience Publishers), 1954. Pp. vii + 136. Price $ 2.50.

cwIN *Research Station, Poona,* Annual Report (Technical), 1950. Research Publication No. 16. (The Manager of Publications, Delhi), 1953. Pp. vi + 100 + vi. Price not given.

*The Charnockite Problem.* By C. S. Pichamuthu. (Mysore Geologists' Association, Bangalore, India), 1953. Pp. 178. Price Rs. 5.

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# SCIENCE NOTES AND NEWS

## University of Madras Lectureships, 1954-55

The Syndicate will proceed shortly to select persons to deliver lectures under the following endowments for the year 1954-55. Applications for lectureships will be received by the Registrar, University of Madras, not later than the 31st March 1954.

(1) *The Maharaja of Travancore Curzon Lectureships* (3).—Three lectures of the value of Rs. 250 each relating to (*a*) Medicine, Clinical, (*b*) Engineering, and (*c*) Agriculture.

(2) *The Dr. Elizabeth Matthai Lectureship* (*Value* Rs. 300).—A course of not less than three lectures to be delivered on a subject embodying the results of original investigations in some branch of Medicine and Surgery, preference being given to a subject having special reference to the requirements of women and children.

(3) *The Dr. Sir A. Lakshmanaswami Mudaliyar Lectureship* (Value Rs. 500).—A course of not less than three lectures on any subject pertaining to Medicine in any of the various departments including Medical, Education, Medical Relief and Public Health and History of Medicine.

(4) *The Dr. Todla Ekambaram Lectureship* (*Value Rs.* 200).—A course of not less than two lectures to be delivered on a subject in Botany with special reference to Plant Physiology.

## Institution of Chemists (India) Associateship Examination, 1954

The Fourth Associateship Examination of the Institution of Chemists (India) will be held in November 1954. The last date for receiving applications from intending candidates is 31st

July 1954. The examination in Group A (Analytical Chemistry) is divided into the following nine sections and the candidate will be examined in any two of them according to his choice, in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry : (1) Analysis of Minerals, Silicates, Ores and Alloys, (2) Analysis of Drugs and Pharmaceuticals, (3) Analysis of Foods, (4) Analysis of Water and Sewage, (5) Biochemical Analysis, (6) Analysis of Oils, Fats and Soaps, (7) Fuel and Gas Analysis, (8) Analysis of Soils and Fertilisers, and (9) Analysis connected with Forensic Chemistry.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

## Symposium on Electro-Chemical Processes and Their Application to Indian Industry

The Symposium will be held in the Central Electro-Chemical Research Institute, Karaikudi, during March 27-28, 1954. It will be inaugurated by Dr. S. S. Bhatnagar.

## Conference on the Physics of Particle Size Analysis

At the Institute of Physics' Conference on "The Physics of Particle Size Analysis", to be held in Nottingham from 6th to 9th April 1954, the following sessions have been arranged : the motion of particles in fluids ; the scattering of light by particles ; the general phenomena encountered in particles size analysis ; the comparison of methods and the automatised methods of particle counting and sizing. Further particulars may be obtained from the Secretary, The Institute of Physics, 47, Belgrave Square, London, S.W. 1.

## Prof. N. F. Mott

Prof. N. F. Mott, Henry Overton Wills Professor of Physics, and Director of the Henry Herbert Wills Physical Laboratories at Bristol University, is to succeed Sir Lawrence Bragg, who for the past 15 years has occupied the Cavendish Chair of Experimental Physics at Cambridge University.

## Underground Laboratory for Cosmic Ray Research

An Australian laboratory for atomic research is to be constructed 50 feet underground at the University of Sydney, New South Wales. Investigators will study the action of mesons, and of the hard components of cosmic rays. The 50 feet of earth above will filter out the protons and electrons, but will not stop the mesons, the depth of whose penetration is not yet known.

The passage of the mesons will be recorded on specially prepared photographic plates, and by means of a cloud chamber. A six-ton electro magnet around the cloud chamber will be used to measure the charge and energy of the mesons.

## Studies at the Weizmann Institute

Exploitation of solar energy, of which Israel has an abundance, forms an important part of researches carried on at the Weizmann Institute in Israel. Special study is being devoted to the production of animal fodder through controlled photosynthesis. Underground water resources are also being explored by the Institute's Isotope Research Department. Through radio-activity tests, it can be determined whether underground water is flowing, or is merely a reservoir with no water sources supplying it. This is very important in areas such as the Negev desert region, where cultivators using subterranean water need to know whether it will be exhausted after a certain period of time.

## Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Geology to Mr. N. Sathapathi for his thesis entitled, "Petrology and Petrogenesis of Nepheline Syenites and Associated Rocks of Koraput (Orissa)".

The Andhra University has awarded the Ph.D. Degree in Mathematics to Mr. B. Viswanatham for his thesis entitled, "Contribution to the Theory of Differential Equations".

The University of Bombay has awarded the Degree of Ph.D. in Chemistry to Mr. T. C. Appanna, for his thesis entitled 'Studies in Prawns and Fish Liver Oils'.

The University of Poona has awarded the Ph.D. Degree in Archæology to Shri Ramachandra Vinayak Joshi for his thesis entitled 'Pleistocene Studies of the Malaprabha Basin'.

# Current Science

## PUBLICATION OF SCIENTIFIC ARTICLES

PUBLICATION in science is the most effective means by which research is encouraged, collaboration between scientific individuals and teams made possible, scientific problems discussed, hypotheses criticised and suggestions made, and scientific information and news disseminated. However, with the phenomenal increase in the applications of science to human welfare and the consequent patronage provided by the public to science, the problem of affording proper publication to scientific studies in relation to the space available in the various journals has become more and more important and difficult. The publication of a research paper is to a large extent based on the co-operation between the author and the editor of the journal in which it is to appear. In this connection, the very pertinent remarks made by Mr. L. J. F. Brimble, Joint Editor of *Nature*, during the course of an address entitled, "Science and the Press" delivered before the Royal Society of Edinburgh recently, deserve careful consideration.

Mr. Brimble draws particular attention to the tendency of authors to send half-baked papers for publication. As he says, it must inevitably be left to the learned societies, editorial committees or individual editors to decide what shall be published, but there is still a tendency these days among scientists to rush into print. More often now than ever before some scientists, having submitted a communication for publication, eventually ask to withdraw it or to be allowed to modify it because they have either discovered an error or have since learnt that some of the work has been done elsewhere. This tendency is also revealed in the appalling state of corrected proofs received from some authors—sometimes peppered with corrections and changes which are anyhow very expensive to make. Rushing into print is also inspired by the bugbear of priority. For example, the request by an author that his communication should be treated as urgent because he has learnt that similar work is being done (usually in the United States) is now treated like the

cry of "Wolf! Wolf!" It is happening far too often. How refreshing it is when one team of workers, having heard that another is working along the same lines, gets into touch with the second group and arranges a joint communication!

There is much complaint today concerning the amount of scientific literature which each scientist must read if he is to keep pace with his own subject. There are many reasons for this overwhelming spate, not the least of which is the over-enthusiasm of scientists themselves. Too many of them imagine that just because they have written a scientific paper it is worthy of publication. The result is that the whole field of our literature extends over a very wide range of scientific merit.

Much of the detail published in a research paper is of limited interest and value. Men of science might well consider publishing only the main points of their research and filing the rest for possible reference. It was the late Lord Rutherford who once said that when writing a letter to *Nature* if you cannot say all that is really necessary in 500 words or less, then something is wrong.

It may not be a bad idea, according to Brimble, if every communication submitted were returned without even being read, with a covering note asking: (1) Are you sure you have said what you want to say? (2) Have you said it in the minimum number of words? (3) Is it worth

saying at all? Too many scientists, especially the younger ones, seem to assume that the value of a scientific paper varies directly as its length. It might therefore be strongly urged that men of science thoroughly train themselves to keep their pens dry until they know the facts or are sure of what they wish to say.

There is no doubt about it that although scientific publications are a valuable contribution to the unity of knowledge, the very great output of records of research has placed scientific societies and journals in a difficult position. The years since the War have also seen the publication of many new learned journals. Some of these have certainly filled important gaps; but by and large one may not say that all this additional publication goes far in solving the problem.

The long rows of periodicals on our library shelves continue to grow; but still the papers come in and the rate of flow increases. This may be a healthy growth in that it reflects the developing activities of men of science, but some form of control seems desirable, for there are all sorts of practical difficulties involved, and the time might well come when it will be impossible to print all the papers, much less read those which are printed. Surely, therefore, we should make it our business to see that our scientifically acquired knowledge is rightly stated if it is to be rightly used.

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## INDO-PACIFIC FISHERIES COUNCIL

THE Fifth Meeting of the Indo-Pacific Fisheries Council was held in Bangkok, Thailand, from January 22 to February 5, 1954. The session was opened by Field-Marshall Phin Chunhawan, Minister of Agriculture, Thailand. The Council was attended by thirteen out of sixteen member-nations. Various matters relating to fisheries development of the countries of South-East Asia were discussed during the session. The Indian Delegation to the Council was led by Dr. N. K. Panikkar, Chief of the Central Marine Fisheries Research Station at Mandapam.

A resolution urging the F.A.O. to establish training centres for master fishermen in the Indo-Pacific area which was moved by India was accepted by the Council. Collaborated projects for the study of the Indian mackerel, *Rastrelliger,* were recommended to those member-governments who have this valuable fishery. Emphasis was laid during the discussions on fish culture, prevention of water pollution by industrial development, and the need for adequate protection of fisheries during the

execution of river valley schemes. Along with the Council's session, a symposium was held on plankton which was jointly organized by the IPFC and the UNESCO, and in which distinguished experts including Prof. A. Thienemann (Germany) and Dr. Fish (U.S.A.), participated. Technical papers bearing on the various problems of fisheries of Asian countries were presented and the delegates took the opportunity to study at first-hand some aspects of the fisheries of Thailand especially the culture of *Tilapia* in the freshwaters of Thailand. The Council accepted the invitation of Japan to hold its next session in Tokyo in October 1955; and elected Nai Boon Indrambarya (Thailand) as Chairman, Mr. J. A. Tubb (U.K.) as Vice-Chairman, Dr. N. K. Panikkar (India) as Chairman of Technical Committee on Biology and Hydrology and Dd. Qureshi (Pakistan) as Chairman of Technical Committee on Technology. For the next session the subject chosen for symposium is: Prawn (shrimp) Fisheries including the biological, fishing and the technological aspects.

# ON CERTAIN NEW ASPECTS OF THE THERMAL PATTERNS ASSOCIATED WITH NOR'WESTERS OVER NORTH-EAST INDIA AND EASTERN PAKISTAN

C. RAMASWAMY AND B. L. BOSE

*The Airport, Calcutta*

IN two recent issues[1,2] of this Journal, the present authors had pointed out that a large proportion of the thunderstorms (with or without surface squalls) in North-east India and Eastern Pakistan in the nor'wester season is associated with cold thermal troughs or cold pools in the middle and upper troposphere, the regions of development of the thunderstorms and their intensities depending upon the positions and intensities of the thermal systems. The authors had also been led to the conclusion from the available evidence that advection of colder air in association with these systems might be the *final* determining factor in the outbreak of these thunderstorms, especially of those associated with typical surface squalls (nor'westers). The authors would like to amplify in the following paragraphs their views about the nor'wester problem a little more in detail :

(*a*) Adequate supply of moist air in the lower troposphere is undoubtedly an important factor in the development of nor'westers; a cold trough or cold pool in the mid- and upper troposphere with dry tropical continental air in the lower troposphere cannot result even in an overhead thunderstorm, much less in the spectacular nor'wester which is often associated with fierce rainsqualls near the ground. To explain this point by one more example, upper level cold troughs and cold pools develop and move across North-west India and Western Pakistan, influencing the weather* over these regions but the incursion of moist air in the lower troposphere in these areas is infrequent and inadequate with the result that the frequency of development of thundery weather is much less than the frequency of development of the cold thermal systems. In contrast to this, in West Bengal, Eastern Pakistan and the adjoining areas, adequate supply of moist air is available *on most of the days* in the nor'wester season on account of the location of these regions with respect to the Bay of Bengal. Consequently,

as pointed out by the authors in their previous papers, the problem of the weather analyst is to judge not whether there is enough moist air to produce the nor'wester but whether the thermal structure in the middle and upper troposphere is favourable or not for the release of the energy† from the moist air.

(*b*) The main role played by advection of colder air in the middle and upper troposphere seems to be to establish the steep lapse-rates required for the development of pronounced instability. An examination of a large number of cases of partial thickness patterns in relation to the actual winds has led us to the conclusion that this thermodynamic process of cold-advection is of great importance in the outbreak of nor'westers. Hence we had tentatively suggested that this cold advection might be the *final* determining factor in the development of the phenomenon. We would, however, point out that there are other processes at work in the middle and upper troposphere which would also contribute to the development of the nor'westers. For instance, one would expect convergence[3,4] and upward motion in the eastern half of the trough and divergence and downward motion in the western half of the trough. Such upward and downward motions in the two halves of the trough would be consistent with the asymmetric distribution of the thunderstorms observed by us. As a matter of fact, we are inclined to the view that thermal vorticity in the middle and upper troposphere is a factor of importance in the development of the nor'wester and that the perturbations associated with this vorticity should increase or suppress the perturbations due to other causes such as orographic lifting, surface heating, etc. The evaluation of the "development term"[5] in the expression for "relative divergence" between different isobaric levels should, in our opinion, give a more quantitative idea of the impulses associated with the thermal trough. This evaluation has been done by one of us for one or two nor'wester situations and the

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*A more detailed discussion of this aspect will be found in a paper by one of the authors in which the monthly normal total and partial thickness patterns at 700 and 500 mb. levels and partial thickness patterns at the 300 mb. level over India and Pakistan are being discussed with reference to the normal distribution of thunderstorms and dust-storms.

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† The mechanisms, available in the lower troposphere, no doubt contribute to the release of this energy but, as shown by the authors in their earlier papers, these mechanisms are less important than those in the middle and upper troposphere.

results have been encouraging. The details of these computations will be published elsewhere.

(c) The development of nor'westers will naturally be a maximum in the afternoon in the plains of West Bengal and Eastern Pakistan as, during this period, the upward impulses in the lower troposphere due to insolation, will be a maximum and in phase with the upward impulses associated with the thermal trough in the middle and upper troposphere. Likewise, in the valleys of Assam, the maximum of nor'wester activity should be in the night as low-level convergence in these valleys and the upward impulses resulting therefrom will be a maximum[6] during the night and will be in phase with the dynamical processes aloft.

(d) The mechanism suggested above does not in any way preclude the possibility of thunderstorms to the west of the thermal troughline, as advection of colder air may take place in this region also by the aid of the wind-shear and due to transport of isotherms. Normally, however, the flow patterns in the nor'wester season are not favourable for such cold advection and hence the thunderstorms tend to be concentrated in the eastern half of the thermal trough.



FIG. 1

With a view to illustrate qualitatively the points brought out in the above paragraphs, the 500 and 300 mb. partial thickness patterns on the evening of the 26th April 1953, are reproduced in Figs. 1 and 2. The thermal patterns for this day have not been discussed by us in our earlier papers and, as such, are of additional interest. The wind arrows in Fig. 1

denote thermal winds between 10,000 and 20,000′. Winds at 18,000′ were used when 20,000′ winds were not available. The wind arrows shown in Fig. 2 denote the thermal winds between 20,000 and 30,000′. The thunderstorms which developed between the 03 G.M.T. of 27th and 03 G.M.T. of 28th have been superposed on the 500 mb.



FIG. 2

partial thickness pattern according to the practice followed in our earlier papers. It will be seen that most of the thunderstorms occurred in the afternoon and evening of 27th. However, as some thunderstorms, *e.g.,* along the foot of the Himalayas, developed before 03 G.M.T. of 27th but later than the mean hour of the thickness pattern, they have also been plotted on the chart. The times of commencement of the thunderstorm have been given in G.M.T. In the case of a few thunderstorms, the G.M.T. timings happen to fall on the 26th, *e.g.,* in the case of Gauhati. Such thunderstorms have been shown enclosed in circles to avoid confusion of dates. The stations which experienced squalls have been shown by the symbol "q" at the bottom of the thunderstorm symbol. The positions of the stations have been shown by black dots.

The nor'wester which swept over the City of Calcutta and its neighbourhood on the afternoon of 27th was of unusual severity. The Calcutta Airport recorded a squall of 82 m.p.h. but the Barrackpore Aerodrome which is about 11 miles to the north-north-west of the Calcutta Airport (as the crow flies) apparently experienced a much heavier squall.

The chief points of interest in the 500 and 300 mb. partial thickness patterns shown in Figs. 1 and 2 are:

(a) In the 500 mb. pattern (Fig. 1), there is an extensive and well-marked cold thermal system between Long. 80° E. and 88° E. advecting cold air to the east. The trough line of this system has been shown by dotted line marked AA'. *Superposed* on this general system are :

(i) A weak thermal ridge over most of Chotanagpur and the contiguous Districts of Bankura and Birbhum in Gangetic West Bengal ; (ii) a thermal trough over West Bengal and East Pakistan between 87° E. and 89° E. with trough line marked BB'. Note the W/WNW thermal winds over Asansol and Jamshedpur and southerly thermal wind over Calcutta. The latter, although weak, continued to be southerly even six hours later as seen from the radar winds and as such it is a significant wind ; (iii) a pronounced warm thermal ridge over the position of North-East India and Eastern Pakistan, north of 23° N. between 89° E. and 92° E.; and (iv) a cold thermal trough over Assam with its trough line marked CC'.

(b) In the 300 mb. pattern, there is a deep cold thermal trough advecting colder air to the east. The trough line‡ has been shown by a dotted line in the diagram. There is also a pronounced confluent thermal jet[7] in the neighbourhood of Calcutta.

An examination of the sea-level and the upper-wind charts for the morning of 27th April shows that the boundary between the dry tropical continental air and the moist air from the Bay of Bengal ran roughly through Cuttack, Midnapore, Bogra, Bhagalpur and Motihari below 5,000' above sea-level.

It is interesting to observe that :

(a) East Uttar Pradesh, East Madhya Pradesh and inland Orissa did not experience any thunderstorms although there was a cold thermal trough at the 500 and 300 mb. levels. The reason for this is that dry tropical Continental air was pervading the lower troposphere over that region.

(b) Practically, the whole of Chotanagpur experienced fair weather *mainly* because of the very poor supply of moist air into that region and partly because of the inhibiting effect of the feeble warm thermal ridge over that region at the 500 mb. level. It is significant that Asansol which is practically over the Chotanagpur Plateau and from which weather usually travels to Calcutta did not experience a thunderstorm on this day. The absence of thunderstorms in the Berhampur-Naya Dumka region which was pervaded by dry continental air is specially interesting as it also shows that the thunderstorms in Gangetic West Bengal were not caused by 'chain-reaction' from the thunderstorms in Bihar.

(c) The portions of West Bengal, Assam and East Pakistan between 89° E. and 92° E. did not experience any thunderstorms in spite of the abundant supply of moist air in these regions. The authors would attribute this to the pronounced warm thermal ridge over those areas between the 700 and 500 mb. levels (the ridge is also seen between 500 and 300 mb. levels but the evidence is incomplete).

(d) The nor'wester which ravaged the Barrackpore Aerodrome and severely hit the Dum Dum Airport had its origin in the flat plains of Bengal not more than 60 miles to the north of Barrackpore to the *east* of the thermal trough line BB' at the 500 mb. level in which region there was not only abundance of moist air supply but there was also pronounced cold advection between the 700 and 300 mb. levels in association with the extensive thermal system mentioned above, besides a very well marked confluent thermal jet between the 500 and 300 mb. levels.

The above paragraphs set out broadly the authors' ideas about the mechanism of the nor'wester. To summarise these ideas in more graphical language, if the nor'wester can be compared to an explosion, the gunpowder required for the explosion is the energy-producing moist air from the Bay of Bengal. This gunpowder may be 'warmed up'—sometimes very well indeed—by the lower tropospheric agencies such as, insolation, orographic lifting and lower level convergence but the powder does not explode. The agency which ignites the powder intrudes into the scene much higher aloft—in the middle and upper troposphere—in the form of cold air advection and vertical movements of air associated with thermal patterns. The result is the spectacle of the nor'wester with its devastating consequences.

1. Ramaswamy, C. and Bose, B. L., *Curr. Sci.*, 1953, **22**, 103.

2. —, *Ibid.*, 1953, **22**, 291.

3. Sverre Petterson, *Quart. Journ. Roy. Met. Soc.*, 1945, **71**, 56.

4. London Met. Office Discussion on cold pools, *London Met. Magazine*, 1953, **82**, No. 969, 81.

5. Eady, E. T. and Sawyer, J. S., *Quart. Journ., Roy. Met. Soc.*, 1951, **77**, No. 834, 531.

6. Bleeker, W. and Andre, M. J., *Ibid.*, 1951, **77**, No. 332, 260.

7. Sutcliffe, R. C., Forsdyke, A. G., *Ibid.*, 1950,**76**, No, 328, 189.

‡ This trough line runs to the west of the trough line marked AA' in Fig. 1. The authors have already pointed out in their earlier paper that the 300 mb. trough line runs to the west of the 500 mb. trough line, on the days of severe nor'westers.

# CALCIUM OXALATE CRYSTALS AS AN INDICATOR OF NUTRIENT BALANCE IN THE TEA PLANT (*CAMELLIA SINENSIS*)

## W. WIGHT AND D. N. BARUA

*Tocklai Experimental Station, I.T.A. Scientific Dept., Cinnamara, Assam*

IN course of investigations at this station it has been observed that the number of calcium oxalate crystals in the phloem parenchyma of the tea leaf petiole is notably constant for a particular phenotype or clone, and is not appreciably influenced by minor variations of cultural conditions. For the purpose of observation, expanded leaves of comparable age are collected and a transverse section of $20 \mu$ thickness is cut from each petiole. A count of all the visible crystals of calcium oxalate in the whole of the phloem parenchyma of the section is made with a low power objective. This number has been called the 'phloem index'.

The phloem indices of three clones, cultivated under full sun in two localities, where soil conditions are slightly different, are given in Table I.

### TABLE I
*Phloem index for plants growing in full sun in localities approximately one mile apart*

| Clone | Locality A | Locality B |
|---|---|---|
| 19/29/13 | $134 \cdot 1 \pm 6 \cdot 60$ | $135 \cdot 2 \pm 7 \cdot 36$ |
| 20/23/1 | $35 \cdot 5 \pm 5 \cdot 05$ | $26 \cdot 0 \pm 2 \cdot 12$ |
| 1/7/1 | $77 \cdot 3 \pm 5 \cdot 74$ | $78 \cdot 6 \pm 5 \cdot 25$ |

For statistical purposes the records pertaining to individual tea plants within an experimental block, have been grouped on the basis of phenotypes roughly similar in respect of



$$y = 0 \cdot 7341 + 0 \cdot 0005375X$$

$$(P < 0 \cdot 01)$$
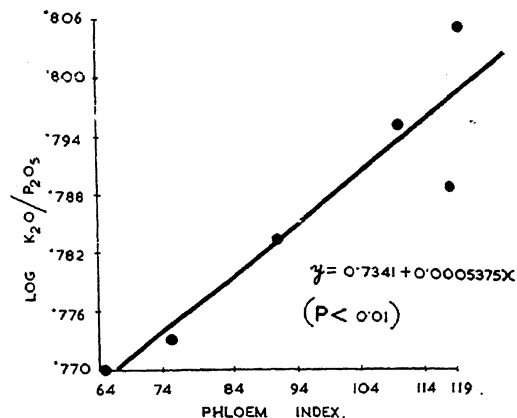
FIG. 1

foliar characters. By assembling separate records of potash and phosphate analyses of leaves removed from these plants in the past, it is possible to construct Table II which sug-

gests that the nature of the relation between the phloem index and the potash to phosphate ratio of a phenotype will prove to be that illustrated in Fig. 1.

### TABLE II
*Mean values for groups of roughly similar phenotypes arranged in a cline of gradations from the Assam type (1) to the China type (6)*

| Groups of phenotypes | $K_2O/P_2O_5$ | Phloem Index $(P_i)$ |
|---|---|---|
| 1 | $5 \cdot 882$ | $64 \cdot 8$ |
| 2 | $5 \cdot 935$ | $75 \cdot 1$ |
| 3 | $6 \cdot 242$ | $110 \cdot 2$ |
| 4 | $6 \cdot 378$ | $119 \cdot 7$ |
| 5 | $6 \cdot 150$ | $118 \cdot 2$ |
| 6 | $6 \cdot 075$ | $91 \cdot 5$ |

When an adequate number of petiole sections is examined from different commercial populations (*jats* or provenances) which are commonly planted in the plains of Assam, then it is observed that the mean phloem index of a population bears a direct correlation to the total number of shoots which are removed in one year by plucking. This is illustrated in Fig. 2 in which each point is derived from one



$$r = 0 \cdot 686$$

$$(P < 0 \cdot 02)$$
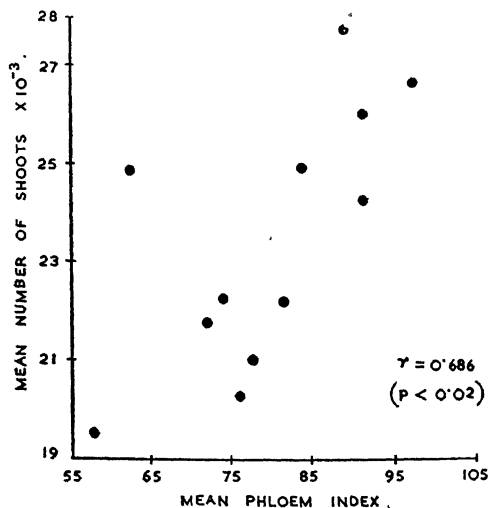
FIG. 2

provenance or population raised from a distinct[*] seed source. The phloem indices were determined in 1951 and the meristic growth in 1952. It is our experience that the between provenance differences in respect of either fac-

tor remain constant in direction. We therefore conclude that a difference in the number of oxalate crystals is associated with a difference in the meristic growth when the magnitude of both these variates is genetically conditioned.

These observations suggest that the phloem index may be of considerable metabolic significance. It appears that the production of oxalic acid increases with the increase in meristic growth and to maintain the acid-base equilibrium in the tissue, proportional uptake of calcium takes place.[4] In view of the well-known antagonism between Ca and K ions,[3] uptake of potassium is likely to diminish as the result of increased uptake of calcium. Some evidence for this is given in Fig. 3 where the ash con-
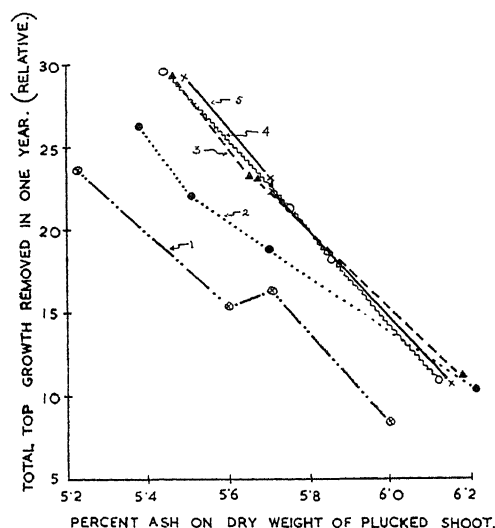


FIG. 3

tent of the plucked shoots, which is composed of about 40 per cent. of $K_2O$, is shown to be inversely related to the green weight of top growth which is removed from a tea bush in one year as prunings and plucked leaf. The numerals 1 to 5 indicate data for five separate provenances.

However, for the relation in Fig. 1 to hold good, any diminution in the potash content of the leaf must be followed by a much larger fall in the leaf phosphate. This could be possible either by a reduced uptake of phosphate or by dilution of the available phosphate in a larger mass of growth.

Whatever may be the cause, the phloem index which is associated with an increased meristic growth, appears to indicate the potash-phosphate balance.

Earlier work at this station[1] showed the potash-phosphate ratio to be associated with

susceptibility of the tea plant to attack by *Helopeltis*. Chapman and Gray[2] found the potash-phosphate ratio to be of importance in determining the response of the oil palm to potash or phosphate manuring.

The mean phloem index of twelve populations of tea plants each raised from a different commercial source of seed (provenance or *jat*) has been determined. The populations have been grown in full sunlight and also under a shade canopy of *Albizzia stipulata* ; and under either illumination intensity have received the two treatments of no nitrogen and 100 lb. of nitrogen as sulphate of ammonia. The design of the experiment is due to F. Yates of Rothamsted and takes the form of partially confounded split plots. The analysis of variance of the phloem index is given in Table III.

TABLE III.
*Analysis of variance of phloem index* $(P_i)$

| Source of variance | D.F. | Mean square | F |
|---|---|---|---|
| Replicate (between block pairs) | 2 ⎫ | 568·308 | .. |
| N × *Jat* | 3 ⎭ | | |
| Shade (within block pairs) | 1 | 21·390 | .. |
| N × *Jat* × Shade | 3 ⎫ | 2492·099 | .. |
| Error | 2 ⎭ | | |
| Blocks | 11 | 1302·129 | .. |
| Nitrogen (within blocks) | 1 | 457·603 | 5·783* |
| *Jats* (Provenances) | 11 | 2230·661 | 28·268† |
| N × Shade | 1 | 123·396 | .. |
| *Jat* × Shade | 11 | 119·184 | .. |
| N × *Jat* | 11 | 77·613 | .. |
| N × *Jat* × Shade | 11 | 159·919 | 2·021* |
| Error | 86 | 79·124 | .. |
| Total | 143 | .. | .. |

* Significant at 5% level;  † Significant at 1% level.

This analysis enables us to conclude that a population of tea plants (provenance) is characterised by a specific phloem index. Light intensity and sulphate of ammonia together but not separately interact with provenance to cause an alteration of the phloem index. In respect of phloem index, the conjoint factors of shade and nitrogen have a differential effect on various kinds of tea population.

The authors wish to thank the Director of the Tocklai Experimental Station and the Indian Tea Association for permission to publish these results.

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# TYPES OF FLOWERING BEHAVIOUR IN RICE 'ORYZA SATIVA LINN.' AND THE DISTINCTIVENESS OF THE AMAN TYPE

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DATE OF EAR EMERGENCE, also called 'Flowering time', has been studied from the physiological as well as the genetic point of view in Japan, U.S.A., India and other countries. It was shown by a number of Japanese workers[1,2] that flowering in rice is hastened by short photoperiods. Some varieties were shown to be definite short-day plants and others to be "less sensitive" in the U.S.A.[3] In India, different types of rice are grown in different seasons. There are autumn-winter (*Aman*), spring (*Boro*) and summer (*Aus*) varieties. It is generally known that *Aman* varieties tend to flower about certain fixed dates in autumn or winter irrespective of the date of sowing while *Aus* varieties tend to flower after a fixed number of days following any date of sowing. Late sown *Aman* varieties flower in spring. It has been suggested that *Aman* varieties require a fixed daylength for flowering which occurs naturally both in autumn and spring.[4] *Aus* varieties are generally considered to be indifferent and *Aman* varieties to be sensitive to photoperiods. Experiments conducted with *Aman* varieties have shown them to be short-day plants.[5] A few *Aus* varieties examined showed that they were not short-day plants but

were possibly long-day ones.[6] Genetic investigations have shown the presence of a number of genes (symbolised as $Fl_1$, $Fl_2$, ....etc.[7]) including an inhibitory gene (*Ifl*) causing monofactorial to multifactorial inheritance of this character. The *Fl* genes have also been found to be linked with other characters (height, etc.)[8,9] in different chromosomes.

During 1951-53, the author grew 31 varieties of rice (10 *Aman*, 5 *Aus*, 2 *Boro*, 8 U.S.A., 5 Japanese, and 1 Javanese) in the open at the Calcutta Presidency College. There was one sowing of every variety every month. The dates of ear emergence were noted and Figs. 1 and 2 show some of the graphs obtained. A striking observation was the uniformity in the flowering behaviour of all the *Aman* varieties and its contrast with *all other* non-*Aman* (Indian *Aus* and *Boro* and *all foreign*) varieties. Twelve monthly sowings of 6 *Aman* varieties showed 54 flowerings during October-December, 18 during January-April and none during May-September. Flowering of *Aman* is fixed during autumn-winter. If that fails, there is a second flowering time in spring. In *all* the non-*Aman* varieties flowering is more or less distributed throughout
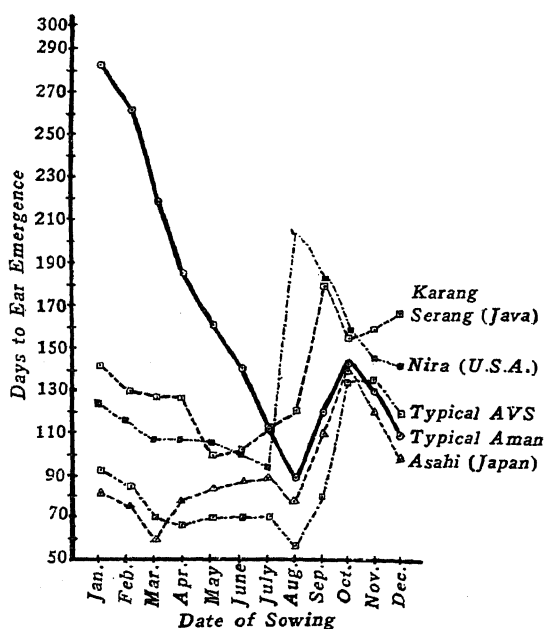


FIG. 1
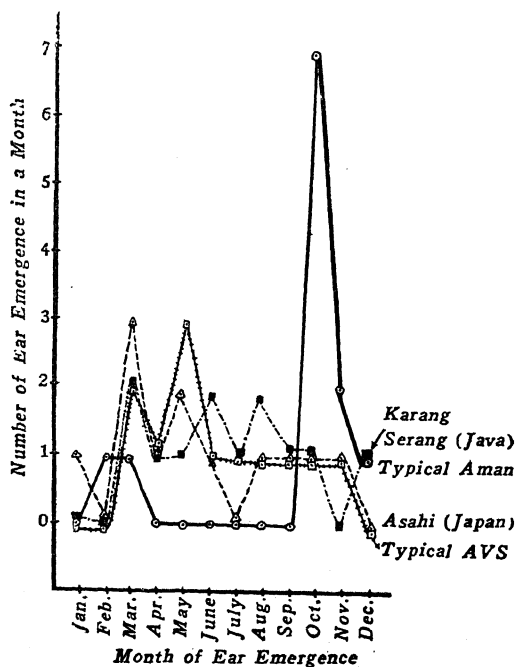


FIG. 2

the year excepting the cold winter months and a consequent increase of flowering in spring.

There is nothing peculiar in the behaviour of the *Aman*, *Aus* and *Boro* varieties which may perhaps be explained by the sensitiveness of the *Aman* to photoperiods and the indifference of the others. But, the same argument does not explain the *Aus*-like behaviour of all the foreign varieties which are known to include many sensitive ones.[1,2,3] In a previous experiment, the author grew (1947 to 1949) six of the foreign varieties (4 U.S.A., 1 Japanese and 1 Javanese—all included in the later Indian experiment) in the U.S.A. in open rice fields during warm seasons and in temperature-controlled green houses during winter. The result is shown in Fig. 3 which shows that two were highly sensitive short-day varieties
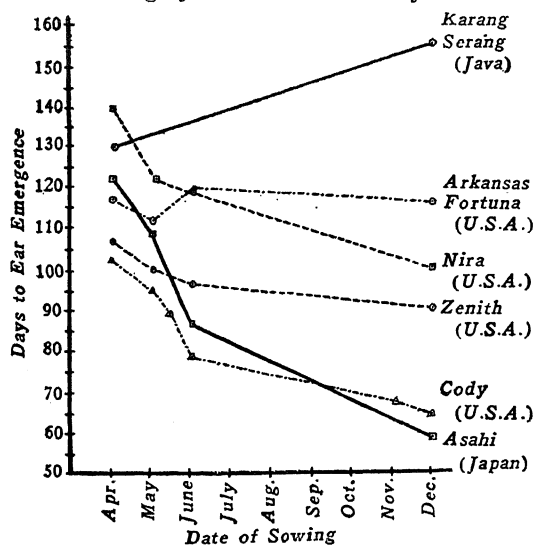


FIG. 3

(Asahi and Cody), three were slightly sensitive or indifferent (Zenith, Nira and Arkansas Fortuna) while the sixth (Karang Serang) seemed to be a long-day one.

The experiment conducted in India, thus, clearly brings out the distinctiveness of the *Aman* type as opposed to all other non-*Aman* varieties. The flowering behaviour of the non-*Aman* varieties, as shown in this experiment, does not show any distinction between short-day, indifferent and long-day varieties and between *indica* and *japonica* types that are included within this assemblage. Possibly, the interaction between daylength and other environmental factors controlling flowering time is different in the *Aman* and non-*Aman* groups.

Further investigation is likely to show that while the *Aman* varieties have a particular *Fl* gene, the non-*Aman* assemblage includes different short-day, indifferent and long-day genes which are differently affected by other environmental factors. Such work is being undertaken. Also, the distinctiveness of the *Aman*, which may be considered as a seasonal ecotype within the *indica* subspecies, may have some bearings on the evolutionary history of the rice species.

A detailed report of the above work will be published elsewhere.

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## UNESCO SCIENTIFIC EXHIBITION IN INDIA

THE second of the mobile scientific exhibitions organised by UNESCO with the co-operation of scientists and manufacturers of scientific instruments is now in India at the invitation of the Indian National Commission for Co-operation with UNESCO. The first exhibition which travelled in the Latin American countries in 1949-50 was prepared on the twin theme of physics and astronomy. The present travelling exhibition which was on view this month at Calcutta is designated as 'Our Senses and the Knowledge of the World'. It consists of about 50 experiments which the public can

perform, and these are divided into five sections, namely, touch, hearing, smell, taste and sight. Twenty illustrated panels explain to the visitor the main points that he should know about each sense.

The Exhibition is in charge of Mr. P. C. Bandyopadhyay who was formerly Assistant Scientific Officer of UNESCO South Asia Science Co-operation Office at New Delhi. The local arrangements are being made by the State Governments, which have invited the Exhibition to various centres.

# THE XIV INTERNATIONAL CONGRESS OF ZOOLOGY, 1953

THE Fourteenth International Zoological Congress was held in Copenhagen, Denmark, during August 5-12, 1953. It was attended by delegates from 48 countries; India was represented by the single delegate from the University of Travancore. His Majesty Frederick IX, King of Denmark, was the Patron and the University of Copenhagen was the host institution.

There were 16 sections, at which nearly 260 communications were discussed, and there were general meetings where about 15 papers were presented. Forming an important event in the Conference was the colloquium on the problems of zoological nomenclature, convened by the International Committee, to discuss a vast number of topics, and in the final session of the Congress, the report and recommendations were adopted. Recently the amendments adopted have been published by Dr. Hemming (see *Nature*, 172, 830, 1953).

With a welcome address from Dr. Th. Kristensen, the Danish Minister, the Conference began. Prof. J. Z. Young, the year's President of the Congress, then delivered his address on "Some Thoughts on Zoological Communication".

Many of the papers read at the various sessions were of a high order, and the discussions which followed were instructive and stimulating. A large number of communications dealt with the results of experimental work. Of especial interest, particularly in the physiology section, were the papers on the giant mitochondria (Dr. C. M. Williams); the neurosecretory cells, their cytology and probable function (in the wake of the First International Conference on Neurosecretion held in Naples in May 1953), and endocrinology of arthropods (Drs. L. Arvy, B. Possompes, M. Dupont-Raabe and others); and polarised light and arthropod vision (Dr. T. H. Waterman). An immense variety of papers was presented, in marine biology, ecology and embryology.

Of great interest was the colour film and the lecture by Dr. A. Fr. Bruun, on the methods and results of the Danish Oceanographic Expedition on the *Galathea*, with the exhibition of some rarities collected by them from the greatest depths at the Philippine Trench.

The Organising Committee led by Prof. R. Spaarck and Dr. A. Fr. Bruun made all satisfactory arrangements for the successful completion of the Congress. The Danish people showed themselves to be the most kindly and hospitable hosts. The excursions arranged for the members were of great biological interest. The Fifteenth Congress is to be held in London, in 1958, with Dr. G. R. De Beer as the President.

K. K. NAYAR.

# SYMPOSIUM ON CERAMIC RAW MATERIALS OF INDIA

A SYMPOSIUM on the ceramic raw materials of India was organised under the joint auspices of the Central Glass and Ceramic Research Institute and the Indian Ceramic Society on the occasion of the latter's Silver Jubilee celebrations at Banaras during February 1954.

The symposium was attended by about 300 people and a special feature was the active interest taken by several of the leading industrialists and technical personnel from the works. Professor W. E. S. Turner of the Department of Glass Technology, University of Sheffield, also attended the symposium.

Forty-eight papers were presented out of which sixteen were read and discussed. The papers related to: occurrence including geology of the deposits; methods of studying raw materials; and methods of beneficiation.

Judging by the number of papers presented and the keen interest of the participants, it can be said that a feeling has been aroused to the need of a proper understanding and utilization of the raw materials in this field.

The symposium was held under the Presidentship of Dr. C. Atma Ram, Director, Central Glass and Ceramic Research Institute.

# GEOLOGY OF INDIA*

DR. D. N. WADIA's *Geology of India* has been a standard work since its publication in 919, for geology students and others interested n the subject. In the third edition there is a onsiderable revision of the subject-matter, and ncorporation of recent work by officers of the ŧ.S.I. and others. The special feature of the present edition is the inclusion of the geology nd mineral resources of Kashmir in the body f the book in the place of a special appendix n the "Geology of Kashmir" in the earlier ditions. In this process, there have necessarily been, in the words of the author, "a few repetitions and overlaps".

In the chapter on physiography, the more mportant additions are about the coasts of Malabar, Mekran and Coromandel; about the gravity measurements reviewing the important vork of P. Evans and W. Crompton, and some additional information regarding earthquakes. n the second chapter, on stratigraphy, a welcome feature is the inclusion of the Standard Stratigraphic Scale, with its subdivisions. This enables the student to correlate Indian stratigraphic divisions with those of the standard scale. Fuller details of the Archæans of Mysore, Central Provinces, Southern Bihar, Gangpur and Mayurbhunj in Orissa, and Himalayas are recorded in this edition. On account of the divergence of views existing with regard to the relative stratigraphic position of the various members of the Peninsular Complex *vis-a-vis* the Dharwars, the author does not give any particular preference to one view or the other. The consensus of opinion, however, appears to be that the oldest recognisable rocks are the Dharwars, and the members of the Peninsular Complex are of a later date.

The chapters on Cuddapahs and Vindhyans are for the most part kept intact, but reference is made to some recent work on the stratigraphic horizon of some of the members of the Purana group and to the reported occurrence of fossils and organic remains in the Vindhyans, suggesting a possible basal Cambrian age to the topmost beds of the Vindhyans. The author's remarks about the Vindhyans and associated rocks of Rajputana are a welcome addition to the chapter. The chapters on Gondwana system have also been revised. Some additional information on the geotectonics of Gondwana

land, and the land bridge between the Gondwana land and the Angara land is given in this edition. A summary of the coalfields of India on page 187 is also new material added now.

In Chapter XV, the age of the Upper Cretaceous of Coromandel coast incorporating some work of Prof. L. Rama Rao and others is reviewed. Additional information on Lametas is also given. In the chapter on the Deccan Traps, the petrography and age of the Traps are brought up to date. In the Tertiary system, the new find of lignite in South Arcot District is mentioned. In the chapter on the Eocene system, the question of the age of the Saline Series is revived with reference to late Prof. Birbal Sahni's contribution in the context of Mr. Gee's views. On pages 332-33 of the same chapter, Eocene succession in Sulaiman range and reference to the find of oil in Potwar Plateau are given. It may be mentioned in passing that the later possibility was proved by the work of Dr. Wadia in the Himalayas. In the Oligocene and Lower Miocene systems, prominence is given to the recent work of Burma Oil Company geologists, thus bringing our information on the subject up to date. The inclusion of a note on the Siwalik fauna is of real value. In the chapter on Pleistocene system, recent work on glaciation in the Himalayas has been excellently summarised. Considerable material has been added to Chapter XXV on the physiography of India. In the last chapter, valuable information on the mineral resources and mineral statistics is given. A welcome addition, almost towards the close of the book, deals with the soil groups of India.

The new edition of Dr. Wadia's book has incorporated most of the recent advances in our knowledge of Indian geology and places in the hands of the students and the public a wealth of information, carefully sifted, properly arranged, and in a flowing style for which his book has always been famous. The get-up, the textual figures and geological sections and map are all that one can wish for. It will continue to have the wide popularity it has enjoyed since its first publication.

C. MAHADEVAN.

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# LETTERS TO THE EDITOR

## APPLICATION OF FERMI'S ATOMIC MASS FORMULA TO THE ESTIMATION OF ALPHA-DISINTEGRATION ENERGY IN THE RARE EARTH REGION

SEVERAL attempts have been made to set up a semi-empirical atomic mass-formula for the estimation of atomic mass M (Z, A) of an element of mass number A and atomic number Z. The mass formulas developed by Bohr and Wheeler[1] and by Bethe-Weizsäcker[2] have been extremely useful in explaining and predicting many of the properties of the nuclei. But their inadequacy in their application to radioactive decay has been well established by many workers. The Fermi-Weizsäcker formula with Stern's correction term,[4] though satisfactory in nuclides for $A \geqslant 212$ for alpha decay energy, has been shown to be inadequate in rare earth region.[5] The systematics of alpha decay properties have been well defined by Perlman, Ghiorso and Seaborg[6] and the properties of possible alpha-emitters have been predicted.

Recent mass measurements by Duckworth[7] and their comparison with the estimated masses have helped to determine a correction-term which fits in well with the experimental results. The calculated masses have been compared with the observed ones in Table I below for Z = 72, 60, 58, 56, 52. From the study of variation of atomic mass with A and Z, the correction to the atomic mass has been estimated to be

$$\Delta m = 0 \cdot 0185 - 2 \left[ kA^{1 \cdot 2} - k_1 Z^{1 \cdot 5} \right] \text{ M.U.} \quad (1)$$

where $k = 0 \cdot 0002$ and $k_1 = 0 \cdot 00014$. The masses calculated using this correction-term are in better agreement with experimental results.

Let us consider an alpha-emitter of atomic mass M (Z, A) and the daughter atom of mass M (Z — 2, A — 4). The alpha disintegration energy is given by

TABLE I

| Nuclides | Mass calculated | Mass observed | Mass calculated using correction term | Nuclides | Mass calculated | Mass observed | Mass calculated using correction term |
|---|---|---|---|---|---|---|---|
| $_{72}Hf^{178}$ | 178·0096 | 177·9936 ± ·0013 | 177·9942 | $_{56}Ba^{137}$ | 136·9653 | 136·9502 ± ·0010 | 136·9505 |
| $Hf^{176}$ | 176·0066 | 175·9923 ± ·0011 | 175·9945 | $Ba^{136}$ | 135·9637 | 135·9488 ± ·0010 | 135·9507 |
| $_{60}Nd^{144}$ | 143·9694 | 143·9560 ± ·0008 | 143·9591 | $_{52}Te^{130}$ | 120·9626 | 129·9467 ± ·0009 | 129·9436 |
| $_{58}Ce^{142}$ | 141·9692 | 141·9537 ± ·0009 | 141·9544 | $Te^{128}$ | 127·9607 | 127·9471 ± ·0010 | 127·9450 |
| $_{56}Ba^{138}$ | 137·9671 | 137·9498 ± ·0009 | 137·9502 | $Te^{126}$ | 125·9573 | 125·9427 ± ·0010 | 125·9449 |

TABLE II

| Nuclides | Observed $E\alpha \times \dfrac{A}{A-4}$ | E$\alpha$ cal. from Fermi's formula | E$\alpha$ cal. using correction-term | Nuclides | Observed $E\alpha \times \dfrac{A}{A-4}$ | E$\alpha$ cal. from Fermi's formula | E$\alpha$ cal. using correction-term |
|---|---|---|---|---|---|---|---|
| $_{61}Pm^{145}$ | ·· Mev. | −0·212 Mev. | 1·638 Mev. | $_{64}Gd^{150}$ | 2·77 Mev. | 0·975 Mev. | 3·001 Mev. |
| $_{62}Sm^{146}$ | ·· | +0·271 | 2·194 | $_{65}Tb^{149}$ | 4·05 | 1·598 | 3·707 |
| $Sm^{147}$ | 2·18 | +0·077 | 1·988 | $Tb^{151}$ | 3·53 | 1·250 | 3·280 |
| $Sm^{148}$ | ·· | −0·140 | 1·760 | $_{66}Dy^{150}$ | 4·11 | 2·033 | 4·205 |
| $Sm^{152}$ | ·· | −0·751 | 1·090 | $Dy^{151}$ | 3·69 | 1·863 | 4·023 |
| $_{63}Eu^{147}$ | 2·87 | +0·730 | ?·670 | $_{67}Ho^{151}$ | 4·31 | 2·425 | 4·660 |
| $Eu^{148}$ | ·· | +0·717 | 2·637 | | | | |
| $_{64}Gd^{147}$ | 3·18 | 1·043 | 3·101 | | | | |
| $Gd^{149}$ | 3·08 | 0·997 | 3·034 | | | | |

$$E\alpha = M(Z, A) - M(Z-2, A-4) - M(2, 4) \quad (2)$$

Substituting Fermi's atomic mass formula[3] E$\alpha$ in Mev. is given by

$$E\alpha = -27\cdot90728 + 13\cdot03610\{A^{2/3} - (A-4)^{2/3}\}$$
$$-77\cdot28545\,\frac{(A-2Z)^2}{A(A-4)} + 0\cdot58383$$
$$\times\left\{\frac{Z^2}{A^{\frac{1}{3}}} - \frac{(Z-2)^2}{(A-4)^{\frac{1}{3}}}\right\} + 931\cdot15\,\{\delta(A, Z)$$
$$-\delta(A-4, Z-2)\} \quad (3)$$

The last term in (2) is zero for A odd, Z (even, odd) and is

$$= \pm 33\cdot52140\,\{(A-4)^{-3/4} - A^{-3/4}\}$$

for A even, Z (even, odd). And the correction to E$\alpha$ is

$$\Delta E\alpha = k_3\,[Z^{1\cdot5} - (Z-2)^{1\cdot5}] - k_4$$
$$\times [A^{1\cdot2} - (A-4)^{1\cdot2}]\ \text{Mev.} \quad (4)$$

where $k_3 = \cdot26072$ and $k_4 = 0\cdot37246$

The calculated alpha-decay energy with and without correction-term has been shown below in Table II along with the observed data wherever available.

It is seen that for $Sm^{146}$ the calculated value is 1·998 Mev. while the observed one is 2·18 Mev. For other isotopes of samarium such as $Sm^{148}$ and $Sm^{152}$ the estimated values are 1·76 and 1·09 Mev. respectively and thus they will have half lives of the order of $10^{14}$ to $10^{15}$ years and hence will behave as stable nuclei. Thus the inevitable conclusion is that the natural alpha-activity of samarium should be definitely assigned to $Sm^{147}$ as has been shown experimentally by Weaver and others.[9] The estimated

value for $Sm^{146}$ is 2·19 Mev., and therefore a part of the natural alpha-activity of samarium may as well be assigned to $Sm^{146}$. The prevailing notion that it does not exist in nature may be due to the fact that its relative abundance is such as to escape detection so far by experiments. The results calculated using the correction-term in case of Dy-isotopes also are in close numerical agreement.

University Dept. of Physics,       G. P. Dube.
Patna University,                  L. S. Singh.
Patna, *January* 16, 1953.

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## MENTAL ESTIMATION OF TIME

THERE have been several studies[1] both in U.K. and U.S.A. about the accuracy of visual estimation of distance, but no study about the mental estimation of time (unaided by watch or counting), appears to have been made. This note presents a study of mental estimation of time by 15 members of staff of the Defence Science Laboratory, New Delhi.

The subjects were requested to mark five periods of 30, 60, 90 and 120 seconds by giving a signal (starting with a given signal). The true periods correct to the nearest second corresponding to their estimations were recorded by means of a stopwatch and were not known to the subjects. The estimations were made in a quiet air-conditioned room in absence of any clock or watch.

### TABLE I

*Regression of estimated time on true time for individual subjects*

| S. No. | $r$ | $a$ | $b$ |
|--------|-------|--------|-------|
| 1  | 0·989 | 12·7   | 0·700 |
| 2  | 0·978 | 2·8    | 1·084 |
| 3  | 0·907 | −13·9  | 0·868 |
| 4  | 0·952 | −18·0  | 1·090 |
| 5  | 0·974 | −30·7  | 1·182 |
| 6  | 0·992 | − 1·1  | 0·840 |
| 7  | 0·998 | −102·3 | 4·310 |
| 8  | 0·982 | 19·6   | 0·806 |
| 9  | 0·957 | 2·0    | 2·089 |
| 10 | 0·971 | 6·2    | 0·769 |
| 11 | 0·972 | 7·3    | 0·792 |
| 12 | 0·964 | −39·0  | 1·433 |
| 13 | 0·999 | − 1·1  | 1·441 |
| 14 | 0·991 | 12·7   | 0·663 |
| 15 | 0·982 | 2·0    | 0·692 |

The correlation between estimated time E and true time T was uniformly high, above 2 per cent. level of significance for all subjects except No. 3, in whose case also it was above 5 per cent. level of significance.

The slope of the regression line of the estimated time on the true time, however, varied considerably—as also did the individual bias in the estimations. These variable features of individual performance are summarised in Table I. In this table $r$ refers to the coefficient of correlation and $a$ and $b$ are the constants in the following relationship between the estimated time E and true time T.

$$E = a + bT,$$

where E and T are expressed in seconds. It is obvious that for perfect estimation $a = 0$ and $b = 1$.

A noteworthy feature of the data, presented in Table I, is that large departures of $a$ from zero are not accompanied by low values of $r$, e.g., when $a = -102·3$, $r = 0·998$. This fact indicates that although estimates by a particular individual may be far from truth, the individual is fairly consistent in his errors for a number of estimates. Thus subject No. 7 has a large negative bias ($a$) and a slope of 4·31, indicating that the typically overestimated time by a factor of 4·31, less a constant bias of 102·3 seconds.

Table II presents the mean and standard deviation of true periods for the five estimations. These data give the following regression equations :

$$\overline{T} = 0·968\,E + 6·8$$
$$\sigma_T = 0·316\,E + 0·6$$

The quantities within brackets in this table are the values of $\overline{T}$ and $\sigma_T$ as calculated from the regression equations which fit excellently with the data.

The authors are extremely grateful to Dr. D. S. Kothari, Dr. R. S. Varma, Dr. A. Seetharamiah and Dr. P. V. K. Iyer for their kind interest in the investigation.

Defence Science Lab.,        MAHENDRA SINGH SODHA.
New Delhi,                          A. K. MEHTA.
*December 7, 1953.*

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### TABLE II

*Mean and standard deviation of true periods*

| E in seconds | | 30 | 60 | 90 | 120 | 180 |
|--------------|--|------|------|------|-------|-------|
| $\overline{T}$ in seconds | .. | 32·9 (35·8) | 66·3 (64·9) | 94·8 (93·9) | 126·3 (123·0) | 178·6 (181·0) |
| $\sigma_T$ in seconds | .. | 10·5 (10·1) | 21·0 (19·6) | 26·3 (29·0) | 39·7 (38·5) | 56·8 (57·5) |

## ADSORPTION OF HYDROGEN AND CARBON MONOXIDE ON A COBALT CATALYST—PRESORPTION EXPERIMENTS*

IN the Fischer-Tropsch synthesis, interaction between chemisorbed carbon monoxide and hydrogen on the catalyst is considered to be an essential step towards reaction.[1] A study of such interaction may indicate the nature of the

substrate intermediates and afford an insight into the basic mechanism of the reaction. We have accordingly investigated the adsorption of hydrogen on a Fischer-Tropsch catalyst partly covered with carbon monoxide and *vice versa*.

The adsorption of hydrogen was determined on 3·73 g. of a reduced Cobalt-Thoria-Kieselguhr catalyst (100 Co : 18 $ThO_2$ : 200 Kg.) on which measured amounts of carbon monoxide were initially adsorbed ('presorbed') at the respective isothermal temperatures following the procedure outlined by Griffin.[2] In all cases the carbon monoxide so admitted was taken up completely and retained by the catalyst as manifested by the absence of any trace of it in the gas phase during the subsequent hydrogen adsorption. The amounts of carbon monoxide presorbed ranged from 0·04 ml. to 2·0 ml. The adsorption measurements on the bare and presorbed surfaces were carried out at 53°, 76° and 97° C. No traces of carbon dioxide, water vapour or hydrocarbons could be detected in the gas phase when the catalyst was treated with a carbon monoxide-hydrogen mixture at 97° C., indicating the absence of reaction. The adsorption measurements on the cleared catalyst were frequently repeated in between presorption runs. The concordance of the values for hydrogen adsorption so obtained checked the constancy of the surface characteristics of the catalyst.

Table I gives the values of $\Delta V_1$, *i.e.*, volume of hydrogen adsorbed on the presorbed surface *minus* the volume of hydrogen adsorbed on the cleared surface under the same conditions.

TABLE I

*Effect of presorbed carbon monoxide on the adsorption of hydrogen*

| Volume of CO presorbed ml. N.T.P. | $\Delta V_1$ ml. N.T.P. | | | | | |
|---|---|---|---|---|---|---|
| | Pressure 30 cm. | | | Pressure 60 cm. | | |
| | 53° | 76° | 97° | 53° | 76° | 97° |
| 0·04 | 0·03 | 0·07 | .. | 0·07 | 0·07 | .. |
| 0·08 | .. | 0·07 | .. | .. | 0·17 | .. |
| 0·20 | 0·29 | .. | 0·70 | 0·56 | .. | .. |
| 0·50 | 0·42 | 0·37 | 0·94 | 0·77 | 0·62 | 1·35 |
| 1·00 | 0·56 | 1·03 | 1·31 | 1·22 | 1·36 | .. |
| 2·00 | .. | 1·23 | .. | .. | 1·73 | .. |

It is seen that the presorption of carbon monoxide enhances the adsorption of hydrogen under all conditions studied. $\Delta V_1$ increases generally with the amount of carbon monoxide presorbed and with the temperature. These results may be compared with those of Griffin on copper and nickel surfaces[2,3] with the significant difference that the suppression effect observed by Griffin at higher pressures is absent in the present case.

The carbon monoxide initially admitted may be expected to be chemisorbed on the most active sites on the surface and cause the enhancement of hydrogen adsorption in two ways: (*a*) the activation of neighbouring centres of low activity, as envisaged by Griffin, and (*b*) complex formation between carbon monoxide and hydrogen involving valence forces. Both these factors may be simultaneously operative. Activation or complex formation may be expected to occur to a greater extent at higher temperatures, giving rise to larger enhancement of hydrogen adsorption at higher temperatures.

On the same sample of the above catalyst, the effect of presorbed hydrogen on the adsorption of carbon monoxide was studied at 53°, 76° and 97° C. The absence of displacement effects and the constancy of the surface characteristics of the catalyst during a series of adsorption experiments were verified as before.

Table II gives the values of $\Delta V_2$, *i.e.*, the volume of carbon monoxide adsorbed on the surface with presorbed hydrogen *minus* the volume of carbon monoxide adsorbed on the bare surface under the same conditions. The amount of hydrogen admitted into the adsorption system did not exceed 1·5 ml. N.T.P. since larger volumes gave rise to measurable amounts of hydrogen in the gas phase during the subsequent determination of the carbon monoxide isotherm.

TABLE II

*Effect of presorbed hydrogen on the adsorption of carbon monoxide*

| Volume of $H_2$ presorbed ml. N.T.P. | $\Delta V_2$ at pressure 20 cm. | | |
|---|---|---|---|
| | 53° | 76° | 97° |
| 0·04 | .. | .. | −0·30 |
| 0·20 | −1·00 | −0·25 | −0·65 |
| 0·50 | +0·35 | −0·45 | −0·85 |
| 1·00 | +1·40 | 0 | −1·00 |
| 1·50 | .. | 0 | −1·10 |

It is seen that at 53°, the first portions of hydrogen upto 0·20 ml. suppress the adsorption of carbon monoxide to a value below that obtained on the bare surface. Evidently this hydrogen is adsorbed on the most active sites to the exclusion of some carbon monoxide. The

next portions of hydrogen, however, cause an enhancement of carbon monoxide adsorption to a value higher than that obtained on the cleared catalyst surface. This difference in behaviour indicates that the latter amounts of hydrogen are adsorbed on sites dissimilar to those on which the first 0·20 ml. was adsorbed.

At 76°, the first portions of hydrogen upto 0·50 ml. cause a suppression of carbon monoxide adsorption and it is only when 1·0 or 1·50 ml. hydrogen is presorbed that the carbon monoxide adsorption comes up to the value obtained on the bare surface. At 97°, all doses of presorbed hydrogen upto 1·50 ml. cause a suppression of carbon monoxide adsorption. The first portions of hydrogen added have a relatively greater suppression effect than subsequent portions.

These results are strongly suggestive of being composed of two opposing effects occurring concurrently on different types of adsorptive sites on the surface. The presence of hydrogen on one causes a suppression of carbon monoxide adsorption; while carbon monoxide adsorption is enhanced with hydrogen present on the second type of sites. The relative extents to which hydrogen is adsorbed on the two types of sites at different temperatures, determine the overall effect on carbon monoxide adsorption.

The authors are thankful to Dr. Sir J. C. Ghosh for his keen interest in this investigation.

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Indian Inst. of Technology, T. S. VISWANATHAN.
Kharagpur, *January* 22, 1954.

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## EXPONENTS OF THE ABSORPTION LAW FOR THE POLAR AND EQUATORIAL REGIONS

JOHNSON[1] suggested that the difference $\delta \ (= \Delta n)$ of the exponents of the absorption law $I = A/h^n$ for the polar and equatorial regions can be determined from an analysis, either of the latitude effect or of the east-west asymmetry. He also pointed out that a higher accuracy can be realised from the latter method. The change in exponent arises from the inclusion in high latitude measurements of low energy rays in

the range $\Delta r_c = 0.5 - 0.35 = 0.15$. The absorption of the asymmetric radiation can be determined from the variation of the asymmetry with the zenith angle. With an increase of zenith angle, the atmospheric path increases but there is also an increase in the energy range within which the asymmetric component lies. To correct for the latter effect, the asymmetry A is divided by the range $\Delta r_c$ of the threshold energies for the two directions involved and multiplied by 0·15, a value selected as a standard range because it represents approximately the range within which the latitude sensitive radiation is included. In Table I are given the asymmetry and other data. The symbol $A' = 1 + 0.15 A/\Delta r_c$ and $h = 9.685 \sec \theta$.

TABLE I

| Zenith angle $\theta$ | Asymmetry A | $\Delta r_c$ | A′ | h | log h | log A′ |
|---|---|---|---|---|---|---|
| 10° | ·038 | ·044 | 1·128 | 9·833 | ·993 | ·0522 |
| 15° | ·059 | ·066 | 1·134 | 10·02 | 1·001 | ·0546 |
| 20° | ·073 | ·089 | 1·123 | 10·30 | 1·013 | ·0503 |
| 25° | ·087 | ·112 | 1·115 | 10·69 | 1·029 | ·0476 |
| 30° | ·091 | ·136 | 1·100 | 11·19 | 1·049 | ·0414 |
| 35° | ·114 | ·161 | 1·106 | 11·82 | 1·073 | ·0437 |
| 40° | ·122 | ·187 | 1·098 | 12·64 | 1·102 | ·0407 |
| 45° | ·121 | ·214 | 1·085 | 13·70 | 1·137 | ·0355 |
| 50° | ·114 | ·241 | 1·071 | 15·07 | 1·178 | ·0298 |
| 55° | ·102 | ·271 | 1·056 | 16·89 | 1·228 | ·0237 |
| 60° | ·086 | ·301 | 1·043 | 19·36 | 1·287 | ·0182 |

The threshold energies at Hyderabad (geomagnetic latitude 7° 39″) are calculated for the zenith angles concerned using the necessary formulæ.[2] The minimum energy allowable at the vertical in India at the geomagnetic equator is 17·0 Bev. after corrections for tilt of the earth's magnetic field and eccentricity of the dipole are taken into account (Neher,[6] Milli-
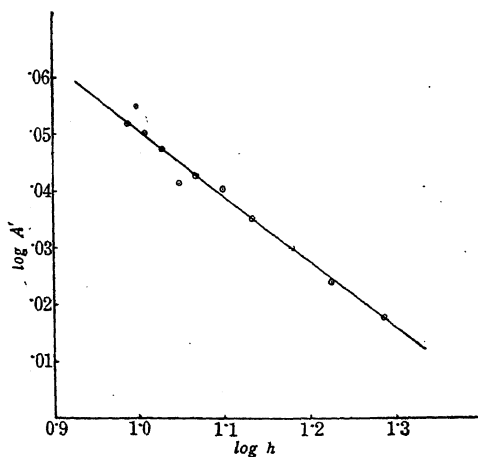


FIG. 1

kan[4]). The values of asymmetry corresponding to the zenith angles have been taken from the asymmetry curve already reported.[5] A logarithmic plot of $A' = 1 + 0.15 A/\Delta r_c$ against the atmospheric path $h$ (Fig. 1) shows that the points lie nearly on a straight line. The slope of this line gives a value of $0.12 \pm .015$ for $\delta$ which is in agreement with that reported by Francis and others[1] for $\lambda = 28° 31'$ while the experiments of Johnson at Peru and Mexico gave a value of 0.16. The probable error is estimated from the scatter of the points in Fig. 1.

The author expresses his grateful thanks to Professor S. Bhagavantam for his valuable guidance.

Physical Labs., D. S. R. MURTY.
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## ISOBUTYL ALCOHOL—ACETIC ACID—WATER MIXTURE AS A SOLVENT FOR AMINO ACIDS

IN the course of an investigation on amino acids using the circular paper chromatographic method, isobutyl alcohol-acetic acid-water mixture was tried as a solvent and found to be quite useful. The $R_f$ values were reproducible to the second decimal place provided the distance of advance of the solvent front was kept constant.

The apparatus and general procedure adopted are based on the method described by Giri and Rao.[1] The amino acid solutions were prepared in concentrations of 0.1 per cent. in 80 per cent. alcohol. 2.5 $\mu$l. of the amino acid solution were spotted at the centre of a Whatman No. 1 filter-paper. For irrigation of the filter-paper, a glass capillary tube of diameter 1-1.5 mm. and length 2 cm. was used in the place of the paper wick. The capillary tube is inserted in a small hole made at the centre of the paper and allowed to dangle into a petri-dish containing the solvent. Irrigation was continued until the solvent boundary had travelled a distance of 5 cm. from the centre and the time taken was about an hour. The paper was then removed, the solvent boundary marked in pencil, dried at room temperature and sprayed with 0.1 per cent. ninhydrin in acetone and dried at 55-60° C. for 30 minutes. The $R_f$ values are the average of four determinations. Solvent: 40 c.c. of isobutyl alcohol, 10 c.c. of glacial acetic acid and 50 c.c. of water. This mixture was allowed to stand for sometime and the lower layer discarded.

TABLE I

*$R_f$ values of amino acids*

| Amino-acid | | Isobutyl alcohol-acetic acid-water | N-Butanol-acetic acid-water[2] |
|---|---|---|---|
| Arginine | .. | 0.28 | 0.32 |
| Lysine | .. | 0.32 | 0.28 |
| Histidine | .. | 0.34 | 0.28 |
| Asparagine | .. | 0.39 | 0.32 |
| Cystine | .. | 0.40 | 0.20 |
| Aspartic acid | .. | 0.44 | 0.37 |
| Glycine | .. | 0.45 | 0.37 |
| Serine | .. | 0.46 | 0.31 |
| Glutamic acid | .. | 0.52 | 0.44 |
| Threonine | .. | 0.53 | 0.40 |
| Alanine | .. | 0.55 | 0.45 |
| Proline | .. | 0.56 | 0.45 |
| Tyrosine | .. | 0.70 | 0.57 |
| Tryptophane | .. | 0.75 | 0.69 |
| Methionine | .. | 0.78 | 0.75 |
| Valine | .. | 0.79 | 0.72 |
| Phenylalanine | .. | 0.80 | 0.75 |
| Isoleucine | .. | 0.90 | 0.75 |
| Leucine | .. | 0.91 | 0.78 |

It can be seen from Table I, that the $R_f$ values of the amino acids as separated by isobutyl alcohol-acetic acid-water mixture are higher than those obtained with N-butanol-acetic acid-water mixture. It is further noted from Table I that arginine occupies the lowest position in the chromatogram. Lysine and histidine which are non-separable with butanol solvent, have distinct $R_f$ values and are well separated. The $R_f$ values show a gradual increase from 0.28 for arginine to 0.91 for leucine. Distinct and well-defined bands are obtained, and hence a useful separation of amino acids can be achieved. Although Consden et al.,[3] reported secondary butyl alcohol as unsatisfactory solvent in that it moved amino acids too fast or unduly broadened the spots, it has been found that isobutyl alcohol-acetic acid-water mixture gave satisfactory results.

My sincerest thanks are due to Dr. S. C. Devadatta, and Dr. K. V. Giri, for their kind interest and continued encouragement.

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Christian Medical College,
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## VITAMIN B₁₂ CONTENT OF THE RAT LIVERS IN ANEURIN AND RIBOFLAVIN DEFICIENCIES

A STUDY of the vitamin $B_{12}$ content of the livers of different animals under normal conditions reveals a comparatively low amount of the vitamin in the livers of rats.[1] In this note is reported our work on the vitamin $B_{12}$ activity of livers of rats in aneurin and riboflavin deficiencies.

White albino rats (males) weighing about 50 g. were used as experimental animals. The experiment was performed in two batches of 48 rats each. Each batch of rats was divided into 4 groups—two for the control and experimental animals in aneurin deficiency and two for those in the riboflavin deficiency. The rats were separated in individual cages and were fed *ad lib* on the purified basal diet.[2] In addition, the aneurin group of rats received 10 per cent. autoclaved brewer's yeast and the riboflavin group of rats received an equal amount of alkali autoclaved brewer's yeast. Each rat of the control groups received aneurin, riboflavin calcium pantothenate and pyridoxine to the extent of 20, 45, 100 and 20 $\mu$g. respectively per day. The experimental animals in aneurin and riboflavin deficiencies received all these vitamins except aneurin and riboflavin respectively. Severe symptoms of aneurin deficiency were observed in about 4 weeks and those of riboflavin deficiency in about 8 weeks. The deficient and control animals were then sacrificed simultaneously. The livers were removed, weighed and analysed for vitamin $B_{12}$ activity by the microbiological method using *Leatobacillus leichmannii*.[3-5] The results are given in Table I.

### TABLE I
*Mean vitamin $B_{12}$ content of control and deficient rats*

| Group | | m$\mu$g./g. liver | Batch |
|---|---|---|---|
| 1 *Aneurin* | | | |
| (a) Control | .. | 55·45 | I–(8)* |
| | | 53·76 | II–(8) |
| (b) Deficient | .. | 24·20 | I–(7) |
| | | 20·46 | II–(6) |
| 2 *Riboflavin* | | | |
| (a) Control | .. | 54·56 | I–(10) |
| | | 52·60 | II–(11) |
| (b) Deficient | .. | 32·79 | I–(9) |
| | | 41·44 | II–(7) |

\* The figures in the parenthesis refer to the number of animals used in the determination.

On applying the 't' test it is seen that the difference in the mean values of vitamin $B_{12}$ in the control and deficient animals is significant at 5 per cent. level of confidence. It appears that a deficiency either of aneurin or riboflavin leads to a deficiency of vitamin $B_{12}$ in the livers of rats. Several workers have reported such definite interrelationships between other members of the B group of vitamins.[2,6,7] The above results suggest that vitamin $B_{12}$ is probably interrelated to aneurin and riboflavin. Work is in progress to study this aspect of the problem in detail. A detailed account of all the work will be published elsewhere.

We wish to express our thanks to the Trustees, Lady Tata Memorial Trust, Bombay, for the award of a research scholarship to one of us (R. V. B.) and to Shri M. S. Nadkarni for statistical analysis of the results.

Biochem. Dept.,                R. V. BHAGWAT.
Institute of Science,          KAMALA SOHONIE.
Bombay, *October 12, 1954.*

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## FEEDING WATER–MISCIBLE VITAMIN A TO DAIRY CATTLE

IT has been reported by Sobel and co-workers[1,2] that the oral administration of aqueous dispersion of vitamin A to lactating animals produces milk with higher vitamin A potency than those fed with oil-soluble vitamin A. Investigations at this Institute[3] revealed that the water miscible form of vitamin A used for fortifying milk remained practically in the aqueous phase and if the milk was mechanically separated, most of the water miscible vitamin A could be recovered in the skim milk. It is not known whether the aqueous form of vitamin A fed to cattle will have any effect on the vitamin A content in the aqueous phase of the milk. Some work has been done in this direction and the results are presented here.

After a preliminary period of 1 week when the animals were maintained on ragi straw alone as roughage, 100,000 i.u. of water miscible vitamin A was fed daily to each animal as

a supplement for 4 days (period II). Later the dosage of vitamin A was doubled for further 3 days (period III) and in the last period (period IV), the supplement of vitamin A was withdrawn. Milk samples were collected daily from each animal and cream was obtained by mechanical separation. The cream was heated to 115° C. and the clarified fat was assayed for vitamin A by the procedure already reported.[4] The results are graphically presented in Fig. 1.
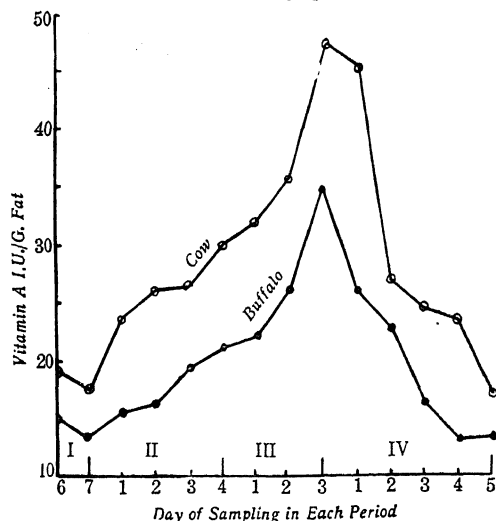


FIG. 1

It can be seen that the feeding of water miscible form increases the vitamin A content of the milkfat and doubling the dosage leads to a further increase. This is true for the vitamin A content of the milk also.

The separated milk was analysed for vitamin A by adopting the method of Koehn.[5] This method consisted in refluxing 100 g. of separated milk with 100 ml. of alcohol and 50 ml. of 60 per cent. KOH for 10 min. and extracting the solution with ether 3 times. The combined ether extract was completely evaporated and taken up in chloroform for the colorimetric determination of vitamin A in the usual way. By using this method the authors were able to account for practically all the vitamin A in separated milk fortified with water-miscible vitamin A. However, no vitamin A could be detected in any of the skim milk samples obtained during periods II and III when the animals were receiving water-miscible vitamin A. This shows that the feeding of water-miscible form of vitamin A leads to an increase in the vitamin A content of the milkfat only without showing any effect on the skim milk. The water-miscible form is thus converted into oil-soluble form in the animal system.

Indian Dairy Res. Inst.,    K. M. NARAYANAN.
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## SYNTHESIS OF SOME 4-PIPERIDONE DERIVATIVES

THE discovery that Pethidine (I) (also called Demerol, Meperidine, Dolantin or Isonipecaine) and Nisentil[1] (II) are potent analgesics has stimulated great interest in the chemistry of piperidines. In recent years, several piperidine derivatives have been synthesised with a view to examine their pharmacological properties. The preparation of compounds of the type II



(I)            (II)
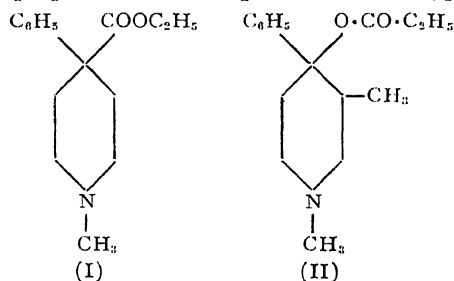
involves the use of 4-piperidones of the type III, and many such compounds have been prepared by employing the method of Noller and Baliah[2] and are reported herein. The reaction may be schematically represented as below:



(III)
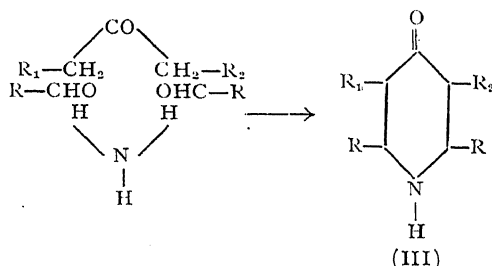
The experimental procedure adopted in each case was as follows: a mixture of the ketone (1 mole), aldehyde (2 moles) and ammonium

| | | | Hydrochlorides | | | | Bases | | |
|---|---|---|---|---|---|---|---|---|---|
| $R_1$ | $R_2$ | R | Yield % | M.P. ° C. | Analyses % Cl | | M.P. ° C. | Analyses % C | H |
| H | $n$-$C_3H_7$ | $C_6H_5$ | 42 | 201–202 | 10·60 | (10·77) | 91–92 | 81·7 (81·9) | 7·6 (7·9) |
| H | $n$-$C_4H_9$ | $C_6H_5$ | 30 | 224–226 | 10·48 | (10·34) | 88–90 | 81·8 (82·1) | 8·2 (8·1) |
| H | $n$-$C_4H_9$ | $p$-$CH_3OC_6H_4$ | 25 | 167–168 | 8·89 | (8·80) | .. | .. | .. |
| H | $n$-$C_6H_{13}$ | $C_6H_5$ | 40 | 192–194 | 9·40 | (9·55) | 110–112 | 82·2 (82·4) | 8·6 (8·7) |
| H | $n$-$C_6H_{13}$ | $p$-$CH_3OC_6H_4$ | 32 | 186–187 | 8·21 | (8·22) | 94–95 | 76·4 (76·0) | 8·2 (8·4) |
| H | $n$-$C_7H_{15}$ | $C_6H_5$ | 30 | 174–175 | 9·02 | (9·21) | 74–75 | 82·0 (82·5) | 8·9 (8·9) |
| H | $n$-$C_7H_{15}$ | $p$-$CH_3OC_6H_4$ | 23 | 193–194 | 8·05 | (7·97) | .. | .. | .. |

acetate (1 mole) in glacial acetic acid (100 c.c.) was heated to boiling and set aside for 12 hours. The addition of ether and hydrochloric acid precipitated the piperidone hydrochloride. It was recrystallised from alcohol-ether mixture. The base was liberated by adding aqueous ammonia to a suspension of the hydrochloride in acetone and pouring the resulting solution into water. It was recrystallised from alcohol. Details regarding the 4-piperidones prepared and of the hydrochlorides obtained are listed in Table I. The quantities within brackets are those calculated from the formula.

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## METABOLISM OF NICOTINIC ACID AND NICOTINAMIDE IN RICE MOTH LARVA (*Corcyra cephalonica* St.)

ALTHOUGH the metabolism of niacin has been studied quite extensively in many species of animals, not much is known about the metabolism of the vitamin in insects. Pearson *et al.*[1] have observed that carnivorous mammals excrete the vitamin mainly as N'-methyl nicotinamide, whereas herbivora lack the capacity to methylate niacin before excretion. The present work was carried out as a parallel to our studies[2,3] on the metabolism of tryptophan in rice moth larva.*

* While the present investigation was in progress, Kato (Kato, M., *Science*, 1953, **118**, 654) reported on the metabolism of nicotinamide in the herbivorous insect, *Bombyx mori*, and in the carnivorous insect, *Lucilia cæsar*, L., and demonstrated the absence of N'-methyl nicotinamide in their excretions.

The experimental diet was the same as described earlier,[4] supplemented separately with nicotinic acid and nicotinamide. Rice moth larvæ, 10-12 days old on whole wheat flour, were maintained on the experimental diets for a period of 4-6 weeks, at the end of which the larvæ had consumed the major portion of the diet. The excreta were collected from the residuary diets and separately extracted with water and the extracts concentrated *in vacuo* and taken up in 50-60 per cent. aqueous ethanol. After centrifugation, the clear supernatants were used for paper chromatography by the ascending technique,[5] against reference standards of nicotinic acid, nicotinamide, nicotinuric acid and N'-methyl nicotinamide. The organic phase of a mixture of *n*-butyl alcohol, methyl alcohol, benzene and water (2 : 1 : 1 : 1) used by Radhakrishnamurty and Sarma[6] for the resolution of the B vitamins gave the most satisfactory separation between nicotinic acid and nicotinamide, and hence was employed in the present study. The ternary nitrogen compounds were located on the chromatogram by the method already described[6] and N'-methyl nicotinamide was detected by the test employed by Reddi and Kodicek.[7] The $R_f$ values of nicotinic acid, nicotinamide, nicotinuric acid and N'-methyl nicotinamide were 0·42, 0·75, 0·30 and 0·26 respectively.

The results obtained with the extracts of larval excreta showed that N'-methyl nicotinamide was completely absent ; on the other hand, the excretory product was nicotinic acid irrespective of whether nicotinic acid or nicotinamide was fed to the larva. This observation indicates that methylation of niacin does not take place in the rice moth larva in contrast to the metabolic path-way in mammals, but that even nicotinamide is deamidated prior to excretion. An enzyme, capable of deamidating nicotinamide stoichiometrically to nicotinic

acid has been found recently in several lactic acid bacteria.[8]

The authors wish to acknowledge with thanks the gifts of nicotinuric acid and N'-methyl nicotinamide kindly provided by Dr. E. Kodicek and Dr. H. P. Sarett.

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# SUPPLEMENTARY NUTRITIVE VALUE OF SOME SUBSIDIARY CEREALS

DURING recent years unfamiliar cereals such as 'Kodra' (*Papsalum scorbiculatum*), 'Rajgira' (*Amaranthus paniculatus*) and 'Wari' (*Panicum miliaceum*), have been used to supplement the staple food grains like rice and wheat. The supplementary nutritive value of these foodstuffs was studied by the growth and nitrogen balance methods and the results are reported here.

1. *The protein being supplied by the cereals under test and red gram* (Growth Method).— 24 albino rats, 40-50 g. in weight, were divided into 4 groups and given a diet containing 8 per cent. protein, of which 3·25 per cent. protein was derived from the different subsidiary cereals under test in each group and the rest was from the pulse red gram (*Cajanus indicus*).

The rest of the diet consisted of 8 per cent. groundnut oil, 4 per cent. salt mixture (Osborne and Mendel), 1 per cent. shark liver oil (containing 1,000 I.U. vitamin A and 100 I.U. vitamin D per gram), the whole being made to 100 g. with starch. Animals were also given 0·1 ml. of vitamin B complex solution containing thiamine 25 mg., riboflavin 20 mg., calcium pantothenate 100 mg., pyridoxine hydrochloride 25 mg. and niacin 100 mg. in 100 ml. Food consumption was recorded daily and animals were weighed twice a week. The results are given in Table I below.

Of the four diets investigated, that containing the proteins of red gram and Kodra was found to have the highest biological value, whereas the Wari-red gram mixture had the lowest biological value.

2. *The protein being supplied by the cereal under test and rice* (Nitrogen Balance Method)— Here adult albino rats weighing 150-70 g. were used. The diets contained 5·68 per cent. of protein, half of which was derived from rice and the other half from the different cereals under test. In all other respects the diets were similar to those used in the growth experiment. The technique employed is similar to that used by Chick *et al.*[1,2] and Swaminathan.[3-5] The results obtained are given in Table II below.

TABLE II

*Biological value of mixed proteins of rice and the subsidiary cereals*

| Group | Biological value % | Digestibility coefficient |
|---|---|---|
| Rice alone | 89·8 ± 0·8 | 86·9 ± 1·1 |
| Rice + Wari | 71·8 ± 5·8 | 90·5 ± 2·3 |
| Rice + Rajgira | 86·2 ± 4·2 | 88·3 ± 1·8 |
| Rice + Kodra | 91·5 ± 2·1 | 89·6 ± 2·4 |

It is clear from the table that the Kodra-Rice and the Rajgira-Rice diets give almost the same biological values as the rice diet alone. Wari is definitely inferior to the other cereals tested,

TABLE I

*Biological values of mixed proteins of subsidiary cereals and red gram*

| Group | Wt. of rats in g. | | Gain in wt. I | Duration in weeks | Food intake in g. | Protein intake in g. P | I./P. |
|---|---|---|---|---|---|---|---|
| | Initial | Final | | | | | |
| Rice + red gram | 43 | 85 | 42 | 11 | 376 | 30·08 | 1·483 ± 0·55 |
| Wari + do | 43 | 68 | 25 | 11 | 378 | 30·24 | 0·837 ± 0·23 |
| Rajgira + do | 43 | 81 | 38 | 11 | 372 | 29·76 | 1·253 ± 0·45 |
| Kodra + do | 43 | 102 | 59 | 11 | 472 | 37·76 | 1·595 ± 0·36 |

either when supplemented to pulse protein or rice protein.

The authors wish to thank Dr. P. M. Wagle for his interest in the work.

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## USE OF GROWTH SUBSTANCES IN THE INDUCTION OF PARTHENO-CARPY IN *LYCOPERSICUM ESCULEN-TUM* AND *CAPSICUM ANNUUM*

Two growth substances, phenoxy-acetic-acid (PAA) and indole-acetic-acid (IAA), have been used in this investigation, the former at a concentration of 10 p.p.m. and the latter at two concentrations, 10 p.p.m. and I p.p.m. The method of study consisted in emasculating the buds at the pre-anthesis stage in 5 plants under each treatment. The emasculations have been made on 3 dates on all the unopened buds present at each date. In the beginning after emasculation, spraying with the hormone concerned was done thrice a week, but as experience showed that all the sprayed buds dropped off without opening into flowers and forming fruits, showing shrivelling before dropping off, at the later dates after emasculation only one spray application of the hormone concerned was given per week, with better results. A greater percentage of the emasculated and hormone-sprayed buds developed into flowers and fruits by such reduction in the frequency of spraying.

TABLE I

*Percentage of parthenocarpic fruits produced under different hormone treatments*

| Plant material | PAA 10 p.p.m. | IAA 10 p.p.m. | IAA 1 p.p.m. |
|---|---|---|---|
| Tomato .. | 30 | 48 | 50 |
| Chillies .. | 43·8 | 47 | 64·7 |

There is a higher induction of parthenocarpy in the weaker dose of IAA (1 p.p.m.) both in the case of tomatoes and chillies. IAA seems to be relatively more effective than PAA. However, in fruit size PAA and IAA at 10 p.p.m. on chillies yield distinctly bigger fruits than the control. In tomato PAA (10 p.p.m.) yielded smaller fruits than the control, but IAA (10 p.p.m.) treatment gave bigger fruits. In IAA (10 p.p.m.) treatment fruit size is of the same order as in the control.

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## CHROMOSOMES OF *SCILLA HOHENACKERI* FISCH. & MEY.

DURING the course of a karyological study of the genus *Scilla*, one of the two Indian species, *S. Hohenackeri,* showed certain hitherto unrecorded facts, which are thought to have a bearing on the evolutionary tendencies within the genus.

Fig. 1 represents the somatic metaphase of *S. Hohenackeri* showing 10 chromosomes. The
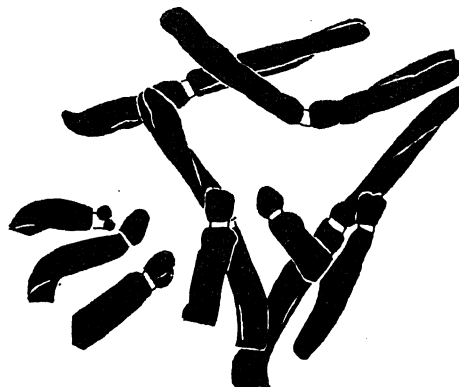


FIG. 1. *Scilla Hohenackeri.* Somatic metaphase, showing 10 chromosomes (from an aceto-carmine smear preparation of a root-tip material prefixed in 0·2% colchicine and fixed in acetic-alcohol, 1 : 3).

chromosome number of the species is not known and such a low diploid number has never been recorded for any other species of *Scilla.*[2] The chromosomes are fairly large with a distinct morphology. The diploid complement consists of two pairs of chromosomes with either median or submedian constrictions and three pairs of chromosomes with subterminal constrictions.

It is indeed remarkable that such a karyotype with the lowest chromosome number so far reported in the genus is asymmetrical. This fact becomes more evident when the chromosome complement of this species is compared with that of *S. siberica* ($2n = 12$[1]), which is characterised by medianly or submedianly constricted chromosomes, and never with subterminal constrictions. This raises the problem of

the evolutionary relationship of *S. Hohenackeri* to the other species.

The second Indian species, *viz.*, *S. indica* is now known to exist in 5 distinct so-called "chromosome races" having $2n = 30^4$, 44, 45, $46^3$ and $58^5$ chromosomes. Interesting is the fact that $2n = 30$, which is the lowest number in *S. indica*, represents a multiple of five, which is the haploid number of *S. Hohenackeri*. Apparently, this chromosome number relationship establishes a certain degree of affinity between the two Indian species.

The writer is thankful to Prof. A. C. Joshi and Dr. R. Misra for the kindly interest, and to Prof. R. Stewart for the bulbs of *S. Hohenackeri*.

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## SUGARCANE RATOONS

RATOONING of sugarcane is a common practice among cane-growers, and is usually adopted owing to its comparative cheapness in cultivation. However, under similar conditions, ratoons are found to come upto maturity earlier and yield less than plant crop. It has been stressed that the yields of ratoons could be raised by bestowing greater care in their culture and nutrition.[2,4] Nagar reported a gradual increase in the yields of the first, second and third ratoons of Co. 312 at Shahjahanpur when nitrogen was applied at 100 lb. per acre.[3] Considerable work was done on this aspect in the Sugarcane Ratooning Scheme at Kalai in U.P.; heavier manuring of ratoons was found not only to reduce insect-attack, but raise the extraction of juice.[1]

A comparative study of the performance of the plant crop and the first two ratoons of Co. 419, all receiving a manurial dose of 100 lb. nitrogen per acre, was made on this Station during 1947-50; and detailed investigations were carried out in respect of plant nutrition and development, effects on soil composition, and the ultimate yield and juice quality.

The yield of cane and sugar per acre was found to be higher for the plant crop than the

ratoons, the second ratoon recording the lowest values. The ratoons attained maturity earlier, and recorded better juice quality. The yield of the first ratoon could be pulled up to the level of the plant-crop by increased nitrogen application (150 lb. nitrogen per acre), but no similar response was observed in the case of the second ratoon. Phosphatic manure application tended to show slight beneficial effect on cane yield when response to nitrogen was limited, as in the case of the second ratoon.

The chief difference between the plant crop and the ratoons noted was that the nutritional level of the plant crop in respect of nitrogen, as revealed through foliar and whole-plant analysis, was of a higher order than the ratoons. The plant crop had a higher nitrogen-uptake during the growth-phase. The over-all nutritional status in respect of N, P and K was lowest for the second ratoon. Correspondingly, the soil under the ratoons contained lower nitrogen. This may be due in part to the fact that the soil does not have a fallow period for recuperation of nitrogen, since the ratoon immediately follows the plant crop. No other broad differences in the soil composition under plant and ratoon crops were noticed in respect of pH, total soluble salts, mechanical composition, exchangeable calcium and available phosphoric acid; but the organic carbon and available potash tended to show an increase with ratooning. The ratoons showed a lower hydration of the plant tissue than the plant crop, and this seemed to induce earlier maturity in the ratoons as reported.

A detailed paper embodying the various items of study including the results of soil and plant analysis, has been sent for publication elsewhere.[5]

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## MORPHOLOGY AND EMBRYOLOGY OF *HELICANTHES ELASTICA* (DESR.) DANS.

THE subfamily Loranthoideæ has been considered to be of great interest because of the variations in the development and organisation of the embryo sac, endosperm and embryo. Although there are more than 50 genera distributed in the tropics, detailed work is limited only to *Dendrophthoe* (Rauch,[6] Singh[8]), *Scurrula* (Rauch[6]) and *Macrosolen* (Maheshwari and Singh[3]). Some other genera have also been studied but the observations are by no means complete (see Pienaar,[5] Schaeppi and Steindl,[7] Smart[9]). In this laboratory Narayana[4] and Dixit[2] have been working on *Lysiana* and *Amyema* respectively. So far there has been no work on the genus *Helicanthes*.

Nearly 8-15 bracteate, sessile, pentamerous flowers are aggregated in a whorl at each node. Open flowers measure 30-43 mm. in length and show a conspicuous 2 mm. long calyculus. The stamens are epiphyllous and adnate for about one-third the distance. The vascular supply of the flower conforms to a pentamerous plan. The calyculus is without any vascular supply.

Microsporogenesis follows the usual course. The reduction divisions are simultaneous and tetrahedral tetrads are formed. The pollen grains are triangular with one germ pore at the tip of each of the three arms. They remain two-celled at the time of shedding. Occasionally 4-rayed pollen grains were also observed.

The narrow stylar canal is continuous with the ovarian cavity which encloses a nipple-shaped mamelon (Figs. 1, 2). Three to five layers below the mamelon differentiates a saucer-shaped collenchymatous pad (Figs. 1-4, c). The entire hypodermal tissue of the mamelon, comprising 30-40 cells, becomes sporogenous (Fig. 2) and several of the cells elongate to give rise to megaspore mother cells which undergo the usual reduction divisions to form linear tetrads (Fig. 4). One or more megaspores of the same tetrad as well as megaspores of other tetrads enlarge and become vacuolated. Thus about a dozen or more embryo sacs are produced (Figs. 5-15). There is widespread degeneration of many cells of the sporogenous tissue and its derivatives.

Due to the growth of the embryo sacs the epidermal layer of the mamelon as well as that of the ovarian canal is completely crushed. The embryo sacs make their way upwards through the stylar tissue and as many as 9-12 of them come to lie in the stylar canal (Figs. 5-15). They extend up to about half the length of the style and clearly show the egg apparatus and the upper polar nucleus. In a 40 mm. long carpel the shortest organised embryo sac measured 4 mm. while the longest measured 16 mm. The lower ends of the embryo sacs are embedded in a mass of degenerated tissue and make their way down to the collenchymatous pad.

Polar fusion occurs in the upper part of the embryo sacs and the fusion nucleus lies adjacent to the egg (Fig. 10). After fertilization the primary endosperm nucleus travels down to the basal part of the embryo sac where it divides to form Cellular endosperm (Figs. 16, 17). Endosperm formation occurs simultaneously in several embryo sacs and the ovarian cells separating the individual embryo sacs are gradually crushed and consumed. Finally the endosperms come close to one another and fuse to form a composite mass (Figs. 18 *A*, *B*; 19).

The first division of the zygote is longitudinal but further divisions are transverse and result in a biseriate proembryo (Figs. 6-8). The earlier divisions take place in the stylar canal but the proembryo soon enters the stylar tissue. Several proembryos, from different zygotes, develop in the same style and in one case we counted as many as twelve. The cells of the suspensor continue to divide and elongate until the proembryo reaches the lower end of the embryo sac, growing down as far as the collenchymatous pad (Figs. 18 *A*, *B*). Mean-

FIG. 1. L.S. ovary showing mamelon at the time of differentiation of sporogenous tissue (diagrammatic), × 8. FIG. 2. Mamelon *m* in Fig. 1 enlarged with adjacent ovarian tissue to show sporogenous cells (reconstructed from several sections), × 190. FIG. 3. L.S. ovary showing mamelon at megaspore tetrad stage (diagrammatic), × 8. FIG. 4. Mamelon *m* in Fig. 3 enlarged with adjacent ovarian tissue to show megaspore tetrads (reconstructed); the outer walls of megaspores comprising the tetrads have been drawn a little thicker to demarcate them from the surrounding tissue, × 190. FIG. 5. L.S. carpel; *A*, *B* and *C* represent the lower middle and upper portions respectively (diagrammatic), × 8. FIGS. 6-15. Upper ends of ten embryo sacs situated in the style shown in Fig. 5 *B*, × 124. FIG. 16. L.S. ovary showing primary endosperm nucleus in lower part of the embryo sac; the mamelon has degenerated (diagrammatic), × 12. FIG. 17. Enlarged view of embryo sacs shown in Fig. 16, × 141. FIG. 18 *A*. L.S. ovary showing terminal part of proembryo surrounded by composite endosperm (diagrammatic). × 6. FIG. 18 *B*. Endosperm and proembryo enlarged, × 17. FIG. 19. L.S. young fruit showing dicotyledonous embryo (diagrammatic), × 6. *c*—collenchymatous pad, *emb*-embryo, *end*—endosperm, *ep*—mamelon epidermis, *es*—embryo sac, *lc*—leathery coat, *m*—mamelon, *mg*—megaspore mother cell, *oc*—ovarian cavity, *par*—parenchymatous tissue, *pen*—primary endosperm nucleus, *pro*—proembryo, *st*—sporogenous tissue, *t*—tetrad, *vl*—viscid layer.
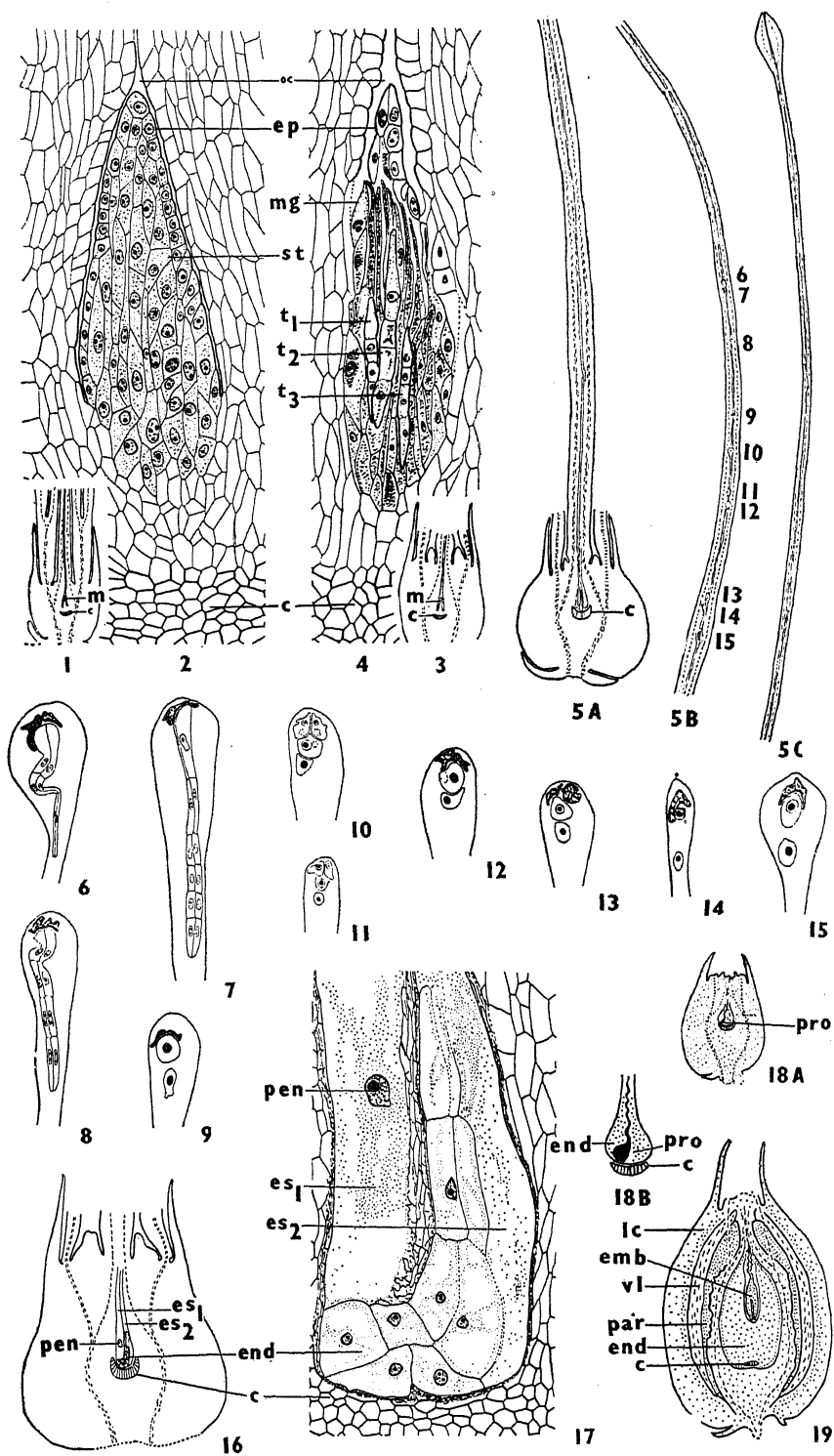
while the terminal embryonal cells divide repeatedly to form a club-shaped mass of cells from which differentiate the two cotyledons. The swollen radicular end organises much later.

The ripe fruit is a "pseudoberry" and consists of three main parts—pericarp, endosperm and embryo. The pericarp comprises 4 zones—an outer leathery coat followed by the viscid, parenchymatous and vascular layers (Fig. 19). The endosperm is vase-like with a solid truncated basal part and a wider, hollow, 5-lobed upper region enclosing the cotyledons. The latter are fused except in the region of the plumule. The radicular end, which represents only the extension of the hypocotyledonary region, closely fits at the apex of the endosperm.

The ovaries of *Dendropthoe, Scurrula, Helixanthera, Taxillus, Barathranthus, Tapinanthus* and *Tupeia* show extreme reduction and there is no trace of a mamelon. In *Macrosolen*, on the other hand, there is a well developed mamelon with three basal lobes. *Helicanthes elastica* is intermediate since it has a conical mamelon but this is devoid of any basal lobes. Therefore, Danser's[1] assignment of *Helicanthes* to the tribe Lorantheae, which includes *Scurrula, Dendrophthoe, Helixanthera,* etc., is considered unsatisfactory. It is suggested that *Helicanthes* should be assigned to a new tribe, Helicantheae.

We are obliged to Prof. P. Maheshwari for his interest in this investigation and for allowing free access to his personal library.

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## EMBRYO SAC OF *SCILLA*

As early as 1880 Treub and Mellink[4] reported that in *Agraphis patula* (*Scilla hispanica*) the embryo sac develops from the upper dyad cell while the lower one does not proceed beyond the 4-nucleate stage. Similar observations have been recorded for several other species; *S. campanulata, S. nutans* and *S. hyacinthoides* (Guignard[4]); *S. campanulata* and *S. hyacinthoides* var. *cœrulea* (McKenney[5]); *S. sibirica* (Schniewind-Thies,[4]); and *S. nonscripta* (Hoare[3]). On the other hand, Govindappa and Sheriff[1] have recently reported that in *S. indica* the embryo sac is monosporic, 8-nucleate and conforms to the Polygonum type. To decide whether the embryo sac is mono- or bisporic, it was considered worthwhile to re-investigate *S. indica* Baker and as some material of *S. hyacinthina* Bach. (collected from the Bogor Botanical Gardens) was also available, opportunity was taken to investigate both the species.

The observations on *S. indica* confirm the findings of Govindappa and Sheriff. The embryo sac is monosporic and 8-nucleate. In addition, a few polyploid 4- and 8-nucleate embryo sacs in the same species have also been observed. The polyploid embryo sacs and their nuclei were almost double the size of the normal embryo sacs.

*S. indica* has a wide distribution in India. Raghavan and Venkatasubban[6] have reported the existence of three aneuploid races ($2n =$ 44, 45, 46) in South India. According to these authors the first two races are morphologically indistinguishable but the third has distinctly broader leaves. Sunder Rao[6] reports the existence of a fourth race from Sagar with 58 somatic chromosomes. In this case the leaves show blotches of dark green to black colour. The material showing polyploid embryo sacs belonged to this race.

In *S. hyacinthina* the hypodermal archesporial cell cuts off a parietal cell (Fig. 1). Occasionally a nucellar cell situated immediately below the megaspore mother cell enlarges in size and somewhat simulates the appearance of a sporogenous cell (Fig. 1). Figs. 3 and 4 show a similar cell below the tetrad. The vacuoles on either side of the nucleus give it the false appearance of a functioning megaspore.

The megaspore mother cell undergoes the usual reduction divisions and the tetrad may be oblique, T-shaped or linear (Figs. 2-6). The chalazal megaspore functions as is evident from Figs. 3-6.

Different types of embryo sacs are not very common within the limits of the same genus but they do occur occasionally. *Nothoscordum* (Messeri[4]) shows Polygonum and Allium types of development while *Erythronium* (Haque[2])

shows both Fritillaria and Adoxa types, *Tulipa* is similar to *Erythronium* in this respect (Bambacioni and Giombini[4]; Bambacioni-Mezzeti,[4] Simoni,[4] and Romanov[4]).
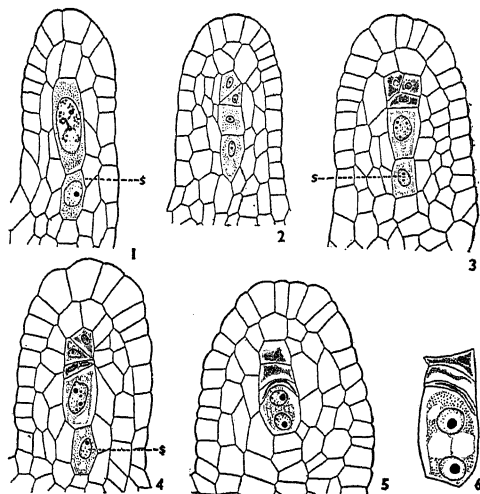


FIGS. 1-6. *Scilla hyacinthina*, Fig. 1. L. S. nucellus showing a megaspore mother cell followed by a sporogenous cell *s*. × 155.

FIG. 2. Tetrad of megaspores. × 155.

FIGS. 3-5. Same, showing functioning megaspore. The non-functional sporogenous cell is marked *s*. In FIG. 4. the third megaspore from the apex shows two degenerated nuclei. In Fig. 5 the nucleus of the functional megaspore has already divided. × 155.

FIG. 6. 2-Nucleate embryo sac. × 250.

It would be of interest to check up other species of *Scilla*.

It is a pleasure to express my gratitude to Prof. P. Maheshwari and Dr. B. M. Johri who suggested the problem and guided the work. Thanks are also due to Mr. H. R. Bhargava (Sagar) for providing the material of *Scilla indica* on which a part of this investigation is based.

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# RAPID VOLUMETRIC METHOD FOR THE ESTIMATION OF NICKEL

THE method was tried with stock solutions of nickel sulphate (5 per cent.) and nickel chloride (2 per cent.). The standard solution of dimethyl glyoxime was prepared by dissolving 2·90 g. of the substance in alcohol and the solution was made up to 500 ml. with alcohol-water mixture, sufficient alcohol being used to get a clear solution. 25 ml. of the stock solution was diluted to 250 ml.

25 ml. of the diluted solution was treated with dilute ammonium hydroxide (till a turbidity appeared or a blue solution was formed). It was then acidified with acetic acid (slight excess). Dimethyl glyoxime solution was then run into this solution 1 ml. at a time (pilot reading), the end point being determined as shown below.

A drop of the reaction mixture was filtered through a strip of filter-paper on to another filter-paper. The red precipitate remained on the first filter-paper and a colourless solution was spotted on the second filter-paper. A drop or two of dimethyl glyoxime was placed on this spot and the colour developed was noted. The disappearance of the red colouration showed the end point. For further readings, dimethyl glyoxime solution was run into the nickel solution within 0·50 ml. of the pilot reading. The reaction mixture was then heated on a water-bath for about 3 minutes and further addition of dimethyl glyoxime was carried out (2 drops at a time), noting the colouration as shown above, till the end point was reached. The final readings can be taken accurate to 0·20 ml. The results compared very favourably with those obtained by the gravimetric method using dimethyl glyoxime in the usual manner, the methods giving values agreeing to within 0·2 per cent. on the same solution.

It was also found that the presence of silver, zinc, iron and chromium ions does not affect the accuracy of the method. Because of colour development, the method cannot be used, as it is, to estimate nickel in the presence of copper and cobalt ions.

Dept. of Chemistry,          SHARAD D. PISHAWIKAR.
Rajaram College,             D. G. PISHAWIKAR.

Kolhapur, *October* 9, 1953.

## AN UNUSUAL RECORD OF A NEMATODE IN AN AVIAN KIDNEY

MATERIALS from an Indian Emerald Dove (*Chalcophaps indica indica*) which died of unknown causes have been sent by the authorities of the Zoological Gardens, Bombay, to the Bombay Veterinary College for histopathological examination and report. These consist of pieces from liver, kidney and intestines. The intestine pieces were opened up and found to contain a number of tapeworms belonging to *Raillietina* spp. and round worms belonging to *Ascaridia* spp. Besides these, a few minute, slender, hair-like nematodes which were indistinguishable from *Ornithostrongylus quadriradiatus,* a parasite which is not uncommonly the cause of losses in pigeons and doves, were also present.

During the histopathological examination of the tissues we discovered a number of nematode eggs in transversely cut gravid parasites embedded in the parenchyma of the kidney sections (see microphotograph). The presence



*Microphotograph of the kidney section showing the parasite*

*A*. Kidney parenchyma showing tubules and glomeruli.
*B*. A transverse section of the parasite showing gravid uterus and intestine.
*C*. A transverse section of a portion of the parasite through the gravid uterus.

of the parasite with fully developed eggs in an avian kidney was quite surprising as it was not reported in literature so far. Worms in the kidney are generally seen in pigs (*Stephanurus dentatus*) and dogs (*Dioctophyme renalis*). The parasite in the kidney could not be studied entire as only a small piece of kidney was available and only a few sections could be cut for histopathological examination.

The findings of the nematode in an Avian kidney is quite unusual and it would be interesting to find out if this is quite common, and if so, what the species involved are.

Bombay Veterinary College,      R. M. KALAPESI.
Bombay, *January* 21, 1954.      S. R. RAO.

1. Baylis, H. A., *Fauna of British India*, 1939, **1**, Taylor and Francis, London.
2. Morgan, B. B. and Hawkins, P. A., *Veterinary Helminthology*, 1949, Burgess Publishing Co., U.S.A.
3. Monnig, H. O., *Veterinary Helminthology and Entomology*, 1947, 3rd Edition, Baltimore: William Wood & Co., U.S.A.

## ALKALINE PHOSPHATASE IN THE NEPHRON OF *RANA HEXADACTYLA* (LESSON)

THE distribution of alkaline phosphatase in the vertebrate kidney has formed a subject of study by a number of workers since Gomori's report[1] of its occurrence in the glomeruli of the cat. It has generally been found that the proximal convoluted tubule, especially the brush border, shows pronounced phosphatase activity in a number of animals,[2,4,5,9] while the glomerulus is ordinarily devoid of it or shows only faint indications of its presence. Under pathological conditions, however, as in choline deficiency[5] in the rat, the glomerulus shows intense phosphatase activity while there is a significant decline in the convoluted tubule. Similarly, in diabetic rats, Kar and Ghosh[2] observed a great concentration of the enzyme in the glomerulus, though Soulairac[8] had earlier reported the complete disappearance of renal phosphatase from the nephron of diabetic rats. These observations have afforded confirmation of the concept prevailing in recent years that the actual absorption of "threshold substances" such as sugar and sodium chloride takes place in the convoluted tubule, while the function of the glomerulus was one of simple mechanical filtration. This difference between the functions of the two parts of the nephron was reflected in the marked difference between the phosphatase activity exhibited by them. Even in cases where the glomerulus showed a positive reaction, it was significantly less than that in the convoluted tubules.

During a recent study of the occurrence and distribution of alkaline phosphatase in a variety of animals under different conditions, it was discovered that the common frog, *Rana hexadactyla* displayed a condition which seemed

interesting. Employment of Gomori's technique showed that under normal conditions, the glomeruli display a pronounced reaction and stand out prominently as regions where perhaps the phosphatase activity is most intense. The proximal convoluted tubule of the nephron also gave a positive reaction but it was not as intense as in the glomerulus. Incubation in the substrate was done for 9 hr. 45 min. which, by experience with this material, is the minimum required for the reaction.
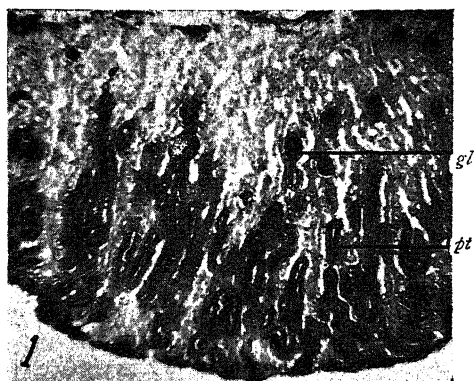


FIG. 1. Transverse section through the kidney of frog, showing pronounced alkaline phosphatase reaction in glomeruli. × 50. *gl.*: glomerulus. *pt.*: proximal convoluted tubule.

The above observation appears to call for a re-orientation of our ideas in regard to renal physiology. The theory of renal excretion originated by the Ludwig school and extended by others in recent years is that the function of the glomerulus is one of mechanical filtration, the energy for which is furnished by blood pressure.[7] As the glomerular transudate passes down the tubule, sugar and sodium chloride are absorbed. During choline deficiency[5] and after bilateral adrenalectomy[6] the nephron of the rat, in striking contrast with the normal animal, shows intense activity in its glomerulus while the convoluted tubule displays a paucity of the reaction. A similar situation is seen in diabetic rats where Kar, Banerjee and Ghosh[3] reported intense activity in the glomerulus and its almost complete absence in the convoluted

tubule.[8] Such a change in the distribution of alkaline phosphatase might possibly be a device for efficient elimination of excess of glucose from the blood; for, the proximal convoluted tubule, judged by the absence of the enzyme, has lost much of its absorptive function, while the glomerulus with its abundant phosphatase activity has taken the role predominantly of a secretory organ. It is significant that the normal condition is restored after insulin therapy.[8]

The occurrence, normally, of alkaline phosphatase in the glomerulus of the frog's kidney would also seem to indicate a situation somewhat analogous to the pathological conditions in the rat. Perhaps in both cases, there is a more rapid secretion of threshold substances by the glomerulus. It seems to indicate that originally the glomerulus performed the functions of both mechanical filtration and secretion, but that during the course of evolution it has lost the latter in many vertebrates, though still maintaining the potentialities for enzymatically controlling the output of the filtrate.

Dept. of Zoology,          T. S. PILLAI.

Central College, Bangalore,    V. K. S. IYENGAR.
*January* 29, 1954.

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# REVIEWS

Table of Natural Logarithms for Arguments Between Zero and Five to Sixteen Decimal Places. NBS Applied Mathematics Series 31. (Govt. Printing Office, Washington 25, D.C.). Pp. 501. Price $ 3.25.

This table is made available to meet a continuing demand for sixteen place tables of logarithms of numbers from ·0001 to 5 at intervals of ·0001. It is a re-issue of Volume III of a four-volume table of logarithms published in 1941.

Logarithms are among the most common mathematical functions. Since four-figure arguments are often sufficient in practice, the practical computer in mathematics, physics and engineering should find this table very labour-saving in view of the fine interval. Whenever the logarithm of a number given to more than 4 places is needed, linear interpolation is usually satisfactory because it gives approximately nine decimal place accuracy over the range of the table.

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Fluorescence of Solutions. By E. J. Bowen and Frank Wokes. (Longmans, Green & Co., London), 1953. Pp. 92. Price 25 sh.

The book under review forms an elementary introduction to the subject of fluorescence of solutions. It contains a brief account of the processes of light absorption and emission, of the factors influencing fluorescence, the kinetics of fluorescence quenching and the methods of fluorescence excitation and measurement. It is divided into ten chapters which deal respectively with the following topics : (I) Fluorescence compared with other radiation ; (II) Energy considerations ; (III) Fluorescence and modern theory of wave mechanics ; (IV) Instrumental factors affecting fluorescence; (V) Theoretical concepts of quenching ; (VI) The kinetics of quenching processes ; (VII) Detection of fluorescence ; (VIII) Fluorimeters ; (IX) Measurement of fluorescence ; and (X) Fluorimetric assays.

In the monograph under reference the author has laid more emphasis on the experimental than the theoretical aspect of fluorescence. He has, however, brought out some of the highlights of fluorescence theory without giving detailed mathematical proofs. A major portion of the book has been devoted to the practical side of fluorescence measurements and inter-

pretation. The principles and apparatus used for fluorescence excitation and measurement have been described in some detail. An account has also been given of the construction and use of commercial fluorimeters and of the methods of evaluating the results.

Students who want to acquire an elementary knowledge of the subject of fluorescence and the methods of measurement will find this book very useful. To those engaged in the identification and estimation of small concentrations of fluorescent materials, the book will be very helpful for getting the correct interpretation of the results.          R. S. K.

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Experimental Inorganic Chemistry. By R. E. Dodd and P. L. Robinson. (Elsevier Publishing Co.), 1954. Pp. xii + 424. Price 42 sh.

This publication is "a guide to laboratory practice" for the benefit of students who are to be initiated to research in inorganic chemistry. The seven chapters dealing with "general basic techniques", "the handling of gases", "preparation and purification of gases and volatile compounds", "water, alkalies, acids, solvents", "colloids and disperse systems", 'physical methods", and lastly "literature, presentation, safety" give in "a compact form a body of information which may be required at short notice in a laboratory". Every statement is fully documented, and hence its prior use would result in a substantial saving of time in the chemical library.

The literature references numbering 765 are in serial order but distributed at the end of each chapter, and the page references are repeated on each page. The particular advantage in this pagewise repetition is not clear.

Two misprints were noticed, one on the very first page, line 6, "conductes" for "conducted", while the other relates to the index reference on boric acid on p. 417, which should read 282 and not 268. The formula for polythionic acids (p. 289) $H_2S_nO_6$ would be less confusing if printed as $H_2S_xO_6$.

The advice given in the last chapter under "recording results and presentation" would be wholeheartedly endorsed by every teacher and supervisor of research. Sample these : "Ideally the laboratory journal should be intelligible to others who might be required to continue unfinished work and, ideals apart, it must be

intelligible to its author ten years afterwards." "Do not despise an English grammar, and use regularly an English dictionary." "Suspense is out of place in a scientific communication."

The value of the book would have been enhanced if a few typical problems for research had also been suggested or some of the unsolved problems in inorganic chemistry mentioned.

The volume can be strongly recommended to every novice in inorganic research as well as to every one interested in the subject, and every chemistry library should have a copy on its shelf for ready reference.      M. R. N.

**Physiological Approach to the Lower Animals.** By J. A. Ramsay. (Cambridge University Press), 1952. Pp. v + 148. Price 15 *sh.* net.

A very noticeable trend in the biological sciences in recent years has been the shift of the emphasis from the purely morphological to the physiological and experimental studies of animals. While the mammalian and in particular human physiology has received the maximum attention, the author rightly points out that a proper understanding of the functional systems of the lower animals is essential before the students can appreciate that man himself is only 'a highly tuned physiological machine carrying out with superlative efficiency what the lower animals are content to muddle through with'. The author has stated in the preface that the book is not intended to be either a text-book of comparative physiology or much less a book of reference. But as an introduction to the subject of the physiology of lower animals, at the upper forms of school and the first year at the Universities, the scope is sufficiently wide and the treatment simple and clear. The author presumes that the reader has a basic knowledge of physics and chemistry and restricts his illustrations to such common types of lower invertebrates as are specified for the more advanced school-leaving examination in England, as recommended by the Cambridge Committee.

The various physiological problems such as digestion, circulation, respiration, excretion and so on are first set forth at the biochemical level and the author has in a simple and lucid manner shown how these problems are solved by the animals, at various levels of structure, in different ways, according to their size, organisation and mode of life.

The text is well written and fully illustrated with simple line drawings and the printing is excellent. The book is heartily recommended as eminently suitable for the use of the undergraduate biology students of our Universities as an excellent introductory approach to the physiology of the lower animals.

P. N. GANAPATI.

**Animal Nutrition Research in India.** By K. C. Sen. (Published by Macmillan & Co., Ltd.), 1953. Pp. xii + 370. Price Rs. 15.

The above monograph by Dr. K. C. Sen, is one of the series of publications issued by the Indian Council of Agricultural Research. It describes the results obtained by research workers in India and compares them with similar work in other countries. In accordance with the original recommendations of Sir John Russel, on the work of the I.C.A.R., the purpose of this volume is to make the results of research known to a wider public.

The author of this monograph is a well-known pioneer in organising animal nutritional research in India for more than three decades. The vast amount of experimental results obtained in the last 40 years has been critically examined and compared by him and the conclusions drawn will be of great help to future workers. The results obtained by Indian workers in foreign laboratories have also been included.

The book is divided into 11 chapters of which the first one gives a general introduction providing the background for the other scientific studies. The cultivators in India depend mainly on the by-products of human foodcrops for the feeding and nutrition of their livestock. Very little effort has been made to grow special foods for animals, it is stated, by which the prevailing under-feeding and malnutrition could be prevented. The chemical composition of Indian feeding stuffs is described in Chapter 2. The techniques employed and the various factors influencing the composition of plant materials are considered in detail. The digestibility and nutritive value of Indian feeding stuffs are dealt in Chapter 3. Most of the work done concerns the bovines and the feeding values of rations for cattle and buffaloes are discussed. Chapter 4 describes protein, sulphur and energy metabolism of animals. The work on mineral metabolism of cattle is discussed in Chapter 5. The conservation and processing of fodders and the use of certain plants and tree leaves as scarcity fodders are given in Chapter 6. Silage making is shown in Chapter 7, to be more suitable for this country than other methods of conservation adopted in other countries. The molasses and bago molasses, the

industrial by-products, are stated to improve very much the deficient village ration for work bullocks, in Chapter 8. Poisonous plants and vitamins and deficiency diseases are described in Chapters 9 and 10 respectively. In the last chapter (II), in addition to the nutrition of milch animals and its effect on their production, a fairly complete account of all the investigations carried out on other aspects of dairy research has also been given to make this part of the review complete.

The numerical data of research have been summarised in 99 tables and 22 illustrations are given. At the end of each chapter, a well classified list of references upto 1948 is found. A glossary of native words for fodders with their Latin equivalents and a classified author index at the end, facilitate easy reference. The neat execution and fine printing of the manual by Macmillan & Co., add value to the results reported.                          V. MAHADEVAN.

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Ayurvedic Flora Medica, Part I. By Vayasakara N. S. Mooss. (Published by Vaidyasarathi, Kottayam), 1953. Pp. 128. Price Rs. 12.

Pharmacognosy of Ayurvedic Drugs, Series 1, No. 2. (Travancore-Cochin.) (Published by the Central Research Institute, University of Travancore, Trivandrum), 1953. Pp. iii + 104.

Indian Pharmaceutical Codex, Vol. I. (*Indigenous Drugs*). By B. Mukerji. (C.S.I.R. Publication, New Delhi), 1953. Pp. x + 431. Price Rs. 12.

*Ayurvedic Flora Medica* deals with 40 medicinal plants arranged alphabetically according to genera from *Abrus precatorius* to *Vitex negundo*. The emphasis on botanical names is proper because research workers all over the world can easily trace the plant without any ambiguity regarding identification. The author has to be congratulated on the care he has taken to get the plants properly identified by taxonomic experts.

The author mentions in the preface the paucity of works containing detailed descriptions of Ayurvedic medicinal plants. Kritikar and Basu have done yeoman work in this field as also Nadkarni. The trail blazed by them is to be followed and this book is a good attempt in that direction.

It would have added considerably to the value of this work if the synonyms in the other regional languages had been given and if a common comprehensive index had been included.

The book would be useful in the pharmacognosy of Ayurveda and to the students of Ayurvedic materia medica.

No. 2, Series I, of the *Pharmacognosy of Ayurvedic Drugs* describes 15 plants and their parts, covering 11 drugs. It is well and profusely illustrated.

Pharmacognosy, as far as Ayurveda is concerned, may be taken as a new science because, as mentioned in the preface, 'verses from the works of Caraka, Susruta and Vagbhata do not give much information of pharmacognistic value'.

In ancient days, the practitioner himself collected and preserved the herbs used by him. But in modern conditions such a course is obviously out of the question. A modern Ayurvedic practitioner has to rely on the supplies of herbs through persons who are not specially trained in any of the technical aspects of their trade. Again, there are not many reputed pharmacists. Under these circumstances it is incumbent on the part of the Ayurvedic physician to be able to separate the wheat from the chaff : considerable help in this direction can be obtained from this book.

While rightly the histological features are given in detail, some attention could also have been paid to the floral parts. The chemical notes which are to be published as an appendix to this work, will no doubt serve to enhance the value of this book, and are eagerly awaited.

The Council of Scientific and Industrial Research has laid the scientific public in general and the Ayurvedic scientists in particular, under a deep debt of gratitude by the publication of the *Indian Pharmaceutical Codex* under review. *The Codex* will serve as a source-book to medical botanists, Ayurvedic scientists and such enlightened non-Ayurvedic medical men as are willing and able to exploit for the benefit of mankind, the enormous resources and potentialities of Ayurveda which has stood the test of time. As Col. Chopra in his introduction says, 'Several items of the vegetable materia medica are well worth recognition not only because they have been popular in local therapeutics for a long time, but also because modern research in their active principles have (*Sic.*) lent a strong support to their being useful in several disease conditions'.

Part I in 256 pages carries general monographs on a number of drugs alphabetically arranged, commencing with *Abroma* and ending with *Zingiber*. Each of these monographs is well written and is worth a detailed study, remembering that there is yet much work to be done regarding identification, chemical composition and pharmacology.

Part II has 125 pages and gives a number of preparations of these drugs with the idea of bringing about some uniformity in the preparation of these medicaments. The value of this part would have been considerably enhanced if a recognised authority on Ayurveda had been included in the Pharmaceutical and Drugs Research Committee.

K. S. RANGANATHAN.

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**An Introduction to Electronics for Physiological Workers.** By I. C. Whitfield. (Macwilliam & Co., Ltd., London), 1954. Pp. 236. Price 18 *sh.*

Electronic instruments have now become part of the routine equipment of medical men and physiologists generally as diagnostic aids, but occasionally as therapeutic agents. Many doctors would welcome a manual which gives an idea of the principles governing the working of these versatile instruments without having to wade through much technical jargon. This handy book is intended for such men and it serves the purpose admirably.

The book begins by giving a brief account of the fundamental laws of direct and alternating current circuits and circuit elements. This is followed by chapters on thermionic emission and thermionic tubes including gas-filled tubes, photoelectric cells, photo-multipliers, cathode-ray oscillographs, and their characteristics. An elementary but adequate account of the various functions which a thermionic tube can satisfactorily perform, such as rectification, amplification, oscillation, filtering, stabilization, triggering, balance control, etc., is given in half-a-dozen short chapters. Principles of the measures adopted for reducing noise and interference are also dealt with adequately.

The author deserves to be commended for his elegant and easy style of presentation of the subject, which includes a few illustrative numerical problems that are worked out in the text itself. Such problems help the reader to gain an insight into the principles of 'compromise' that are so essential a feature of all practical instrument designs. Analogies such as muscle stretch-receptor and proprioceptive afferents introduced to familiarize the reader with the feed-back principle in amplifiers are very helpful.

Fig. 9, 4 on p. 98 may perhaps mislead the non-technical reader for whom this book is primarily written. This figure gives the impression that flat frequency response over a wide range can be realized with negative feed-back without any reduction in amplification. This is not quite correct. It is true that in the text itself expressions are given for amplification with and without feed-back which imply that amplification is automatically reduced with negative feed-back, but in the figure explicit mention of this important fact is not made in words. In a book intended for the biologist and the doctor, one feels that such explicit mention is essential.

The volume is fully illustrated with explanatory figures and is nicely got up. It deserves to find a place on the bookshelves of every biological and medical library.

M. V. GOVINDASWAMY.

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**Biological Transformations of Starch and Cellulose.** Edited by R. T. Williams. (Biochemical Society Symposia, No. 11.) (Cambridge University Press), 1953. Pp. 84. Price 10 *sh.* 6 *d.*

The book under review is a collection of papers communicated to the Biochemical Society's Symposium held at the London School of Hygiene and Tropical Medicine in February 1953. After a brief introduction by Stanley Peat, a fairly complete survey of the various aspects of biological synthesis of starch is given by E. J. Bourne. This is followed by an article on the enzymic breakdown of starch by W. J. Whelan and another on starch synthesis and degradation *in vivo* by Helen Porter. Cellulose and cellulases are discussed in the next two articles by G. O. Aspinall and M. V. Tracey respectively, while the two concluding articles are of special interest, in that A. T. Phillipson deals with the digestion of cellulose by ruminants and R. G. Fargher discusses the occurrence and prevention of the biological attack of cellulosic textile fibres.

According to Peat, the entire vegetation of the world has been estimated to contain carbon equivalent to $10^{12}$ kg. of carbon dioxide, and as the greater part of this carbon is to be found in two polyglucoses—starch and cellulose, the biological changes which take places in these two substances are of very great importance. This monograph, by giving a comprehensive account of the subject, serves an exceedingly useful purpose and it is to be hoped that many more in this series will in future be published on other interesting aspects of biochemistry.

P. S. SARMA.

**Report on the Model Experiments for Bokaro Barrage D. V. C.** By N. K. Bose and H. N. Mukherjee. (Damodar Valley Corporation, Calcutta.)

The report on the model experiments conducted at the River Research Institute, Bengal, for determining the flood levels, the position and profile of the Bokaro Barrage emphasises the need for hydraulic experiments before finalising designs. As a result of the experiments, it was found that by retiring the left guide bank, the accumulation of sand at the upstream left flank of the barrage could be minimised and the section of the barrage could be changed, making it more economical and efficient. In addition, it was also possible to verify the accuracy of many of the levels the river was supposed to have touched at various places during the record floods of 1935. Regarding experiments on the accumulation of sand at the left bank of the barrage, a few sets of experiments on the disposition of silting that is likely to occur due to different ratios of discharges in the Bokaro and Konar Rivers could have given more information on this problem. It is not clear why other remedies like silt vanes were not tried to prevent accumulation of sand. No mention has been made of the allowance to be made for the effect of distortion of horizontal and vertical scales on the lines of flow observed in the model.

Regarding experiments on the design of the profile of the barrage, the nature of flow that occurs beyond the toe of the bucket for low discharges could have been studied. It is well known that the nature of the flow can be shooting, create a surge, or get drowned depending on the tail water-level in the river. This in turn may create either a positive or a negative vertex flow at the toe and may cause retrogression of levels. It is important to run the model for all conditions of flow through the barrage and the corresponding tail-water conditions so that the most critical condition of flow may be determined. The cill proposed to form the bucket can be cut at intervals to allow the pebbles and shingles to pass through them and also drain out the flow that may accumulate in the buckets when all the gates are closed.

The report is exhaustive and is well prepared with numerous figures and photographs. The research workers are to be congratulated on the thoroughness with which they have carried out their studies.

N. S. GOVINDA RAO.

**Books Received**

*The Mind and the Eye.* By Agnes Arber. (Cambridge University Press), 1954. Pp. xi + 145. Price 16 *sh.* net.

*Analysis of Deformation,* Vol. 1. By Keith Swainger. (Chapman & Hall), 1954. Pp. xix + 285. Price 63 *sh.*

*Progress in the Chemistry of Fats and Other Lipids,* Vol. 2. By R. T. Holman, W. O. Handberg and T. Malkin. (Pergamon Press, Ltd.), 1954. Pp. 348. Price 63 *sh.* net.

*Tables of Coefficients for the Numerical Calculation of Laplace Transforms* (NBS Applied Maths, Series 30). (Govt. Printing Office, Washington 25 D.C.). Pp. 36. Price 25 cents.

*The Biology of the Cryptic Fauna of Forests.* By R. F. Lawrence. (A. A. Balkema, 1, Burg Street, P.O. Box 3117, Cape Town). Pp. 408. Price 50 *sh.*

*Nature and the Greeks.* By E. Schrodinger. (Cambridge University Press), 1954. Pp. 97. Price 10 *sh.* 6 *d.* net.

*Fifth Conference on Cotton Growing Problems in India.* (The Indian Central Cotton Committee, Ballard Estate, Fort, Bombay), 1953. Pp. xii + 116. Price Rs. 4.

*A Colored Atlas of Some Vertebrates from Ceylon,* Vol. 2. By P. E. P. Deraniyagala. (Ceylon National Museums Pub.). (The Ceylon Government Press). Pp. xvii + 93. Price not given.

*Advances in Carbohydrate Chemistry.* By C. S. Hudson and M. L. Walfrom. (Academic Press, Inc., Pub.), 1954. Pp. xvii + 408. Price $ 10.00.

*The Printing of Mathematics.* By T. W. Chaundy, P. R. Barrett and Charles Batey. (Oxford University Press), 1954. Pp. ix + 105. Price 15 *sh.* net.

*Tables* 10 (Antilogarithms to the Base 10). (N.B.S. Applied Maths. Series 27). (N.B.S. Office of Scientific Publications), 1953. Pp. viii + 543. Price $ 3.50.

*Mammalian Hybrids.* By Annie P. Gray. (Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England), 1953. Pp. x + 144. Price 21 *sh.* net.

*The Biochemistry of Genetics.* By J. B. S. Haldane. (George Allen & Unwin, Ltd.), 1954. Pp. 144. Price 15 *sh.*

*Rocket Propulsion,* Second Edition. By Eric Burgess. (Chapman & Hall), 1954. Pp. 235. Price 21 *sh.*

## SYMPOSIUM ON CHROMOSOME BREAKAGE*

THE suspicion that chromosome breakage and rearrangement may be one of the causative agents of malignancy has highlighted a study of these phenomena which had already assumed importance in view of their presumed role, along with gene mutations, in organic evolution. The foundation for investigations on chromosomal breakage had been laid nearly three decades back, when Muller discovered that the rate of their spontaneous occurrence could, like gene mutations, be accelerated by exposure to radiations. In spite of this, active work in this field is of very recent origin.

The volume under review consists of twenty-four papers which have been arranged in four parts, *viz.*, (*i*) Radiation Breakage, (*ii*) Chemical Breakage, (*iii*) Secondary and Spontaneous Breakage, and (*iv*) General. Even though the phenomena dealt with are of sufficient importance to warrant a careful perusal by biologists belonging to the different disciplines, the use of specialized and exclusive terminology and symbols has tended to make the contributions intelligible only to those who have actively followed work in this field.

Many of the earlier conclusions have had to be modified in view of the evidence now available that chromosome breakages may be of different types. "Now we see that with each kind of treatment, the period of breakage may be limited in its own way. And with each kind of cell or nucleus, the period of union may be similarly limited or concentrated" (p. vii). There are many differences between the action of radiations and chemical mutagens. Unlike ionising radiations, chemical mutagens are capable of inducing breakage of heterochromatin in resting nuclei. In *Vicia,* while the breakage induced by chemicals is of chromosomes, the union is between chromatids.

The doubt is engendered whether breakages induced by chemicals are comparable to those arising after exposure to ionising radiations. As Revell remarks: "There is thus no *a priori* reason to expect that effects produced by mutagenic chemical compounds should show the same random distribution as those produced by ionising radiations, since there is no reason to suppose that a chemical substance can act on the chromosomes in the sort of randomly corrosive fashion which has sometimes been assumed" (pp. 107-08).

The tetraploid cells and diplochromosomes seen in X-rayed tissue of *Triticum* (pp. 86-89) are attributed to the suppression of mitosis. During tissue differentiation the cells are known to become endopolyploid. Such transformations take place in the absence of a spindle. Whether ionising radiations could be used as a tool in investigations on the problem of endopolyploidy in relation to tissue differentiation would be worth attention. Reference is made by La Cour (pp. 173-74) to the very high percentage of breakage in the activated cells of the pericycle as a result of damage to the meristem. Unfortunately evidence is not available that differentiated cells when activated are all capable of normal dedifferentiation.

The cytological changes that accompany tissue differentiation still remain unexplored. Under the circumstances, it would be sheer optimism to expect that by pulling apart the chromosomes and thus the genes we would be able to get an idea not only of "how they work" but also of "what is needed to make them work" (Darlington, p. v). A careful perusal of published literature relating to *Drosophila* would show that when a cell becomes endopolyploid there may be differential reproduction of (*a*) chromosomes constituting the mitotic complement, (*b*) eu- and hetero-chromatin of the same chromosome, and (*c*) may be of even the different regions of the euchromatin. If these changes really do occur, different genic balances would be produced in different tissues. Thus the final picture may have no relation to what is seen in meristematic or germ cells. As Darlington states, the Symposium has produced answers to questions "that did not concern us more easily than those that did" (p. viii).

The volume would be a welcome addition to any cytological library.

M. K. SUBRAMANIAM.

# SCIENCE NOTES AND NEWS

### 'Ekaholmium'

The Atomic Energy Commission, U.S.A., has announced that a new element, number 99, has been produced. This is the seventh artificial element to be added to the list of the traditional 92 chemical elements.

The new substance has an atomic weight of 247, is radio-active and short-lived and in a few minutes changes into element 97. It is not likely to be useful for atom bombs or power; it is not fissile. As with all the new elements heavier than uranium, number 99 was made by adding nuclear particles to uranium. The new element to which no name has yet been given is chemically related to holmium.

### Germanium from Lignite

Since the discovery in 1952 that lignite contained germanium, trials have been made to extract germanium economically. It is now reported from Japan that these trials have been successful and that a factory is being established near Tokyo for its extraction. It is hoped to produce 5 lb. of germanium oxide from 400 tons of lignite a month. Plants for the manufacture of metallic germanium are to be added later. In addition to germanium, the factory will produce tar, activated coal and gallium.

### Fat from Fungi

S. Murray, M. Woodbine and T. K. Walker (*J. Exp. Bot.*, 4, 11, 251; 1953) have reported on the growth, development and fat formation of some forty-three strains of ten species of fungi when grown on different sucrose-containing media. The highest three yields of felt were given by *Pencillium javanicum* van Beyma, *P. soppi* Zaleski and *Aspergillus nidulans* Eidam, in that order. The fat content on felt weight was maximal at 34·8 per cent. with *P. soppi* at 28·4 per cent. with *Fusarium lini* (I), and at 25·8 per cent. with *A. nidulans*; on sugar utilized it was maximal at 11·4 per cent. with *P. soppi*, at 7·9 per cent. with *A. nidulans*, and at 5·6 per cent. with *F. lini* (I). Other moulds are also being considered in this connection.

### Fossils 2,000 m. Year Old

Plant fossils believed to be the oldest yet and estimated more than 2,000 million years old have been discovered on the northern shore of Lake Superior. The discovery was made in a deposit of flint rock in an iron formation near Schreiber, Ontario. The fossils were found to be blue green algæ and simple forms of fungi. Professor Patrick Hurley of the Massachusetts Institute of Technology determined the age of the fossils.

### Translations of Russian Papers on Physics

Arrangements have been made in the USA to translate some 1,000 pages of current Soviet papers on physics during 1954. At the same time new terms will be recorded for incorporation in a Russian-English scientific glossary. The translations will be published by the U. S. Atomic Energy Commission, and copies will be purchasable from the Office of Technical Services, Department of Commerce, Washington, D.C.

### UNESCO Translation Guide

Bibliographical notes on 16,130 works translated in 49 countries are contained in the fifth volume of "Index Translationum", an International Bibliography of Translations, which has just been published by UNESCO. A book of 512 large-format pages in French and English, it covers translations published during 1952 and also translations issued since 1948 which had not been listed in the previous volumes of the Index. Some of the countries in the new volume are represented for the first time; others, which had previously appeared with only fragmentary bibliographies, are now presented in more or less complete detail.

The compilation of "Index Translationum" represents the combined efforts of bibliographers all over the world. The work, which every year becomes larger and more complete, is a valuable working instrument not only for library workers, publishers and translators, but generally for all persons interested in the exchange of ideas and knowledge between peoples and between the great cultural zones. Price $ 7.50; 42 *sh.*; 2.00 frs. on sale at National Distributors of UNESCO Publications.

### UNESCO Aids to Science Teaching

UNESCO is publishing a series of 80 workshop designs, or "blueprints" for the produc-

tion of school science equipment by small industries or by vocational schools. There is one portfolio of 80 drawings for elementary schools and another of 76 drawings for secondary schools and university laboratories. They are prepared in the international engineering code and the drawings themselves contain no words so that they are useful in any language. Accompanying them are sheets with full specifications for the purchase of the raw materials, instructions for manufacture on a small scale and on a large scale and instructions for the use of the equipment by the teachers. With the aid of the "know-how" provided by UNESCO's drawings, many underdeveloped countries will be able to establish the manufacture of scientific equipment and instruments which is essential for science teaching in the schools.

UNESCO has also undertaken to organize science teachers' Associations in various countries and is engaged on the continuing study of the curricula used in science teaching throughout the world.

## World Medical Periodical

The UNESCO has just published a bibliographical guide, of more than 250 pages to World Medical Periodicals including journals devoted to dental and veterinary surgery as well as pharmaceutical organs. This highly useful reference work has been priced at 12 *sh.* 6 *d.*

## Third International Congress of Nutrition

The Congress is to be held during September 13-17 at Amsterdam and is expected to serve as a forum for exchange of views on various aspects of nutrition problems. The Organizing Committee sincerely hopes that numerous students of this vast and interesting field, especially also the younger persons, will seize this opportunity of coming into contact with research workers of experience and renown. The main emphasis will be on symposia on the topics: "Nutrition and Disease" and "Food Additives", as these subjects are at present being studied with particular interest. Applications for membership should reach the Secretariate, J. D. Meyerplein 3, Amsterdam, before 1st April 1954.

## Symposium on Vegetation Types of India

The Indian Botanical Society will be holding a Symposium on 'Vegetation Types of India' at the annual meeting to be held at Baroda in the first week of January 1955. Workers in the field are invited to participate in the deliberations and inform Dr. R. Misra, the Convener, Department of Botany, University of Saugar, Sagar, immediately of the title of the paper they would like to read. The manuscript with a brief abstract should reach him before September 1954. It is proposed to publish the Symposium at an early date.

## Progress of Botany in India

With reference to the Progress Report sponsored by the Indian Botanical Society on the above and announced in our Journal (1953, 22, 295), the following changes have been forwarded to us for notification: (4) Pteridophyta—Mr. N. P. Chowdhury, Lecturer in Botany, University of Delhi, Delhi-8, in place of Dr. T. S. Mahabale. (10) (b) Ecology—Dr. G. S. Puri, Forest Ecologist, Forest Research Institute, New Forest, Dehra Dun, in addition to Dr. R. Misra. (12) Vegetative Anatomy of Angiosperms—Dr. G. C. Mitra, Department of Botany, University of Delhi, Delhi-8.

The last date for submission of reports has been extended up to July 1, 1954.

## Award of Research Degree

The University of Saugar has awarded the Ph.D. Degree in Genetics to Shri Y. Sundar Rao for his thesis entitled "Karyo Systematic Studies in Helobiales with Some Observation on Genisteæ".

The University of Saugar has awarded the Ph.D. Degree in Botany to Shri S. C. Pandeya for his thesis entitled "Ecological Studies of Grasslands of Sagar".

The Gujarat University has awarded the Ph.D. Degree in Chemistry to Shri B. P. Bangadiwala for his thesis entitled "Studies in the Synthesis of Hydroxy Quinolines and Halogenation of Ethyl B-arylaminocratonates".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri K. R. Chandorkar for his thesis entitled "Synthesis of 6-Benzoyl-4'-methoxyflavone and 5-benzoyl-4'-benzylidenecoumaranone by Kostanecki and Feurstein reaction, etc.".

# CENTRAL WATER AND POWER RESEARCH STATION, POONA*

THE Central Water and Power Research Station, Poona, is perhaps the largest engineering organisation in the country with a record of useful service extending for nearly forty years. During the last decade alone, the Station has investigated nearly 200 important problems relating to measures for the protection of bridges against outflanking, of weirs against breaches by floods, exclusion of sand and silt from irrigation canals, and training of rivers.

The history of the growth of irrigation and power in our country is amply reflected in the history of the Station which began its work modestly as a Special Irrigation Division of the Bombay Public Works Department in 1916. Local problems of land drainage, reclamation and a study of the principles of water-flow

engaged its attention at first. Soon, the Bombay Government found that the Research Division could put forth concrete solutions to problems, saving time and money, and promptly raised it to the status of a Hydrodynamic Research Station in 1920.

At that time the models were situated on a distributary of the main Right Bank canal of the Mutha River near Hadapsar. Despite limited facilities, the Station tackled problems connected with the design and construction of the famous Sukkur Barrage and its canals in Sind (then a part of Bombay Province). The success of the investigation brought in its train increased demands for the solution of a wide variety of engineering problems. But the water-supply for working models was inadequate at the distributary. Later models, therefore, began to be built from 1925 on the main Mutha Canal below Lake Fife at Khadakvasla. By 1934 the entire Station moved over to the new site,

Twenty years of increasingly useful life have shown that the foundations of the Research Station had been well and truly laid. By experimenting on scale models and perfecting the designs, it has saved crores of rupees in the construction of engineering projects in the country. The usefulness of the Station was so well established that the Central Government decided to take it over in 1937 and extend its services to all the provinces and states in India. New fields of irrigation and river training research were added on, and the Station was renamed as the Indian Waterways Experiment Station.

Ten more years of tackling problems from all over the country showed that it called for further expansion. A scheme of re-organisation and establishment of new branches was accordingly sanctioned by the Central Government. The new branches of research include navigation, soils, materials of construction, statistics, physics, mathematics and hydraulic machinery. Under the scheme the Research Station became, in 1948, a wing of the Central Water and Power Commission.

Except for the model research laboratory which calls for heavy and constant supplies of water, the other sections are housed in Poona. At Khadakvasla, design problems relating to most of the major river valley projects, harbours and estuaries are being solved through scale models.

Among the navigational problems that are under study at the Station, the most complicated is that of the Hooghly. Every year 40 lakhs of rupees are being spent for silt and sand removal from ship channels between Calcutta and the sea. An unceasing watch has to be kept on the depth of the tortuous course ; and there are reaches where the silting, and therefore the dredging, never stops. But it is pleasant to be able to record that the experiments

on the models at the Poona Station have already started yielding promising results. An oblique spur of 1,300′ thrown from a selected spot on the bank in the Sankrail reach has succeeded in routing both the flood and ebb tides along the right bank instead of on opposite banks. In other words, ships will be assured of a constant, perennial channel in that reach without the labour of dredging.

The Hooghly Expert Committee appointed by the Government to examine the problems and solutions or the navigability of the estuary has recommended the construction of the spur in the Sankrail reach. Somewhat less complicated, but equally vital to the nation, are the problems of the Madras, Mangalore, Kandla and Cochin harbours that are being investigated at the Station.

Apart from the models, extensive research is also carried on by the Station on various subjects relating to sound engineering construction. Suitability of indigenous soils as binding material, or load-bearers or for soil cement; analysis of the geological structure of dam sites by creating light, artificial earthquakes; lines of stress and strain in various designs of structure through the use of bakelite models and polarised light; statistical estimation of water-flow in river channels from their catchments : these are some of the subjects that are under constant study at Poona.

The services of the Central Water and Power Research Station have extended even beyond the frontiers of India. On the basis of model experiments at Poona on the *Ye-U* Canal taking off from the *Mu* river in Burma, measures have been recommended to exclude sand from this important irrigation canal. Thus through its growing activities and its steady service, the Central Water and Power Research Station has indeed served as model for a number of other organisations in the country.

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## SIR S. S. BHATNAGAR

S IR S. S. BHATNAGAR, Secretary, Ministry of Natural Resources and Scientific Research, and Director of Scientific and Industrial Research, has been elected President of the International Committee on Scientific Research of the UNESCO.

# THICKNESS OF THE GANGETIC ALLUVIUM NEAR CALCUTTA
## AS DEDUCED FROM REFLECTION SEISMIC MEASUREMENTS*

### L. N. KAILASAM
*Geological Survey of India, Calcutta*

THE alluvial tract in the Ganges Delta has of late received considerable attention and publicity, particularly in regard to the possibilities of occurrence of petroleum in the rocks underlying the alluvium. The Ganges Delta, as is the case with the rest' of the vast Indo-Gangetic Plain, is known to be covered by a thick mantle of alluvium. The Indo-Gangetic alluvial tract is believed to be a synclinal basin, the age of this depression being Upper Eocene, though its maximum development is believed to have occurred during Middle Miocene times. The depth of alluvium in this basin is presumed to be maximum on its northern margins, the floor of the basin rising steadily towards the south as it shelves up towards the mass of the Indian Peninsula. Geodetic data seem to indicate a maximum thickness of the order of 6,500' for the alluvium in Bihar.

The existence of some major and minor 'upwarps' and 'downwarps' has been postulated by Glennie[4,5] to explain some of the observed geodetic anomalies. He has suggested a crest line under the Gangetic alluvium north of Calcutta sweeping around as a great arc between Allahabad and Banaras extending to Shillong. He believes a minor downwarp to occur as another sweeping arc in a north to south direction through Jalpaiguri and extending south-west to Dhulian, but suggests no downwarp through or near the Ganges Delta. Fox believes that the Ganges-Brahmaputra Delta is a "tectonic downwarp produced by the thrust from the Burma, Hill Tippera and Assam range direction westward towards the Bihar Plateau". The alluvium is believed to be shallow between the Rajmahal and Garo Hills which are apparently connected by an underground ridge. Glennie has stated that the Gangetic trough of Bihar and the United Provinces does not extend below the Delta into the Bay of Bengal. A glance at the Geological Map of India shows the presence of the Durgapur beds believed to be of Supra-Panchet age cropping out near the Damodar River to the north-west of Calcutta while immediately to the south and south-west of the Durgapur beds lie the igneous and metamorphic rocks interposed by the Lower Gondwana formations. On the eastern side of the Delta, to the east of the Megna River are the undifferentiated Tertiaries. What lies underneath the

alluvium in between is a matter for speculation. No marine shells have been discovered in the alluvial deposits of the Delta. A number of tube wells have been sunk in and near Calcutta during the past 100 years or more, for purposes of ground water-supply and the deepest of these is the Akra Road well sunk in Garden Reach near Calcutta and taken to a depth of 1,306' without reaching the base of the alluvium. The bore hole log for this well revealed several alternations of clay, sand of varying texture, kankar and pebble beds and also a bed of sandstone and clay of 6½' in thickness at a depth of 1,017'.

The author recently carried out some Reflection Seismic measurements in the Sodepur (22° 42′ N ; 88° 23′ E)-Madhyamgram (22° 41′ N ; 88° 28′ E)-Barasat (22° 43′ N; 88° 29′ E) area in the 24 Parganas near Calcutta on an experimental basis to test whether the method can be used with advantage in this area for exploration purposes and to study the seismic characteristics of the area, i.e., the probable distribution of average velocity with depth, the quality and number of seismic reflections, etc. A modern portable 24-channel reflection seismic equipment manufactured by Messrs. Technical Instrument Co., Houston, U.S.A., was used. Charges of 2 lb. and occasionally more of explosives were used in shot holes at depths of 10-16' from the ground surface. Fortunately, such shallow shot holes and small charges proved sufficient as the water table in this area lies at quite small depths varying from 10-20'. The 'split-spread' arrangement of shot-point and detectors was employed following the continuous profiling method. Observations were made along two profiles, one in an approximately east-west direction running from Sodepur to Madhyamgram and the other in a NNE direction from Madhyamgram to Barasat and beyond obtaining in all over 100 records. Generally six well-defined 'reflections' were recorded in the seismograms. A specimen record obtained along the Madhyamgram-Barasat highway is reproduced below :

Of these, the third, fourth and fifth reflections were found to be the most consistent. Reflection 6 has not been always recorded. This could reasonably be attributed to the fact that sufficient energy could not always be impressed to the deeper horizons owing to the shallow nature of the shot holes and the small quantities of charge used. Deeper shot-holes could not be drilled owing to the lack of a regular

3

Shot instant →

REFLECTION 1

REFLECTION 2

REFLECTION 3
Base of Alluvium

REFLECTION 4

REFLECTION 5

REFLECTION 6

SECONDS
(Time)
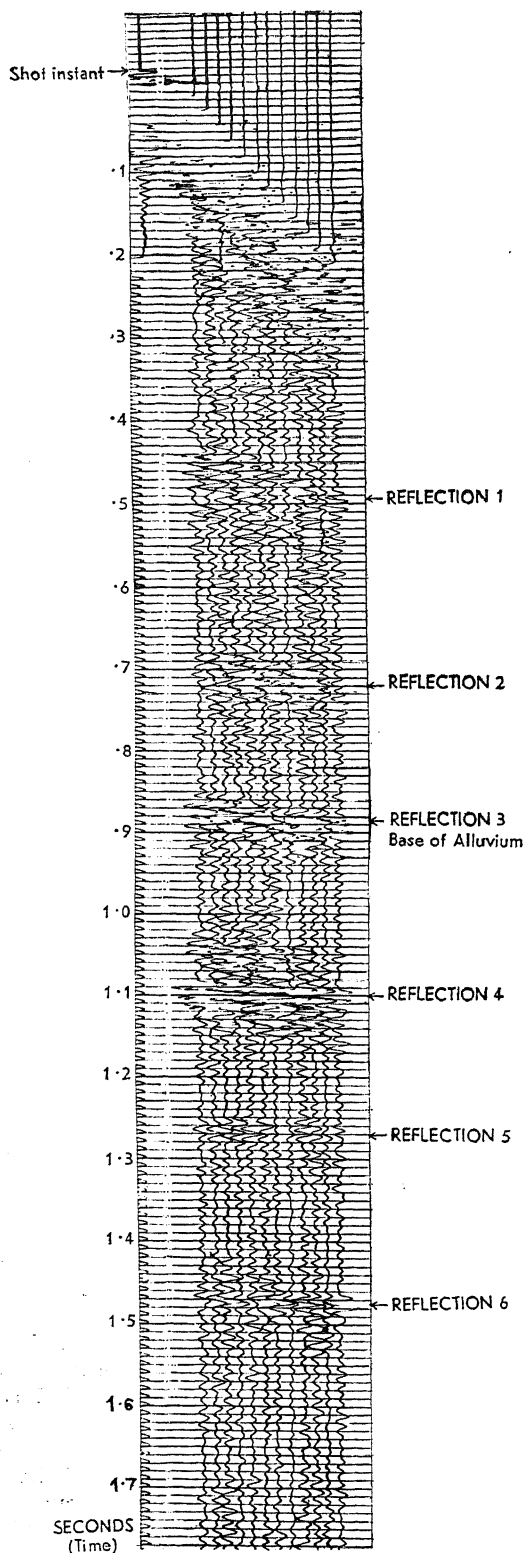
seismic shot-hole drilling equipment. Normally, one would expect that the first of the recorded reflections would represent the base of the alluvium which is a discontinuity of marked geological and seismic contrast and should, therefore, provide clear and strong reflections. An analysis of all the seismograms shows that the first two reflections, in addition to the erratic nature of their arrival times, are neither so clear nor so pronounced as the third and the later ones. Again the computed depth to the first reflection is only of 1,000' whereas it is known from the results of the Akra well that the alluvium is thicker than 1,300'. The second reflection occurs at depths varying between 1,500-2,200' and as pointed out are quite erratic. Also, the arrival times for the first two reflections do not tally on the east-west and north-south profiles whereas those for the later reflections do. For these reasons it seems reasonable to infer that the third reflection represents the base of the alluvium in this area, the thickness of which would then vary within a range of 2,500-3,000'. The first two reflections will then have to be attributed to some inter-alluvial phases which act as reflecting horizons. The existence of such phases is quite likely and understandable, when we bear in mind that the alluvium is not at all homogeneous in depth as shown by the results of the Akra Road well which for instance, as has already been pointed out, revealed the existence of a sandstone bed of 6½' in thickness at a depth of 1,017'. It also seems reasonable to infer that the reflecting horizons represented by reflections later than the third are the interfaces of consolidated sedimentary rocks beneath the alluvium. This is indicated from a study of the variation of average velocity with depth.

The alluvial area seems well suited for the application of the Reflection Seismic Method and useful indications of the structure of the underlying formations may be obtained as an aid for oil exploration.

1. Fox, C. S., *Physical Geography for Indian Students*, 1938, Macmillan & Co.
2. Oldham, R. D., "The Indo-Gangetic Plain" *Manual of the Geology of India*, 2nd Ed., 1893, 427-58.
3. —, *Mem. Geol. Surv. Ind.*, 1917 **42**, pt. 2.
4. Glennie, E. A., *Geod. Rept. Surv. India*, 1935, 46.
5. —, *Ibid.*, 1937, 24.
6. Coulson, A. L., *Mem. Geol. Surv. Ind.*, 1940, **76**.

# THE HYDROGEN BOMB*

LITTLE is known publicly about the construction of the hyrdogen bomb; but most probably it is based on the fusion of hydrogen nuclei into helium nuclei, taking place at very high temperatures. The temperatures necessary for such reaction are of the order of millions of degrees and can only be produced by a fission bomb; the hydrogen bomb must thus be triggered by a fission bomb. It is fairly certain that hydrogen is the main material for thermonuclear bomb, for the fusion of heavier elements requires much higher temperatures and produces less energy; but ordinary hydrogen is not suitable, and either deuterium or tritium has to be used.

The main advantage of the hydrogen bomb is that there is no essential limit to its size.

It is a very safe explosive, for it will never go off unless fired by the fission bomb. The latter, on the other hand, is by nature unsafe and goes off the instant it is assembled, which puts a practical limit to its size. The load capacity of modern aircraft would, however, limit the explosive power of the hydrogen bomb to about a thousand times that of the fission bomb. The radius of damage of such explosive would thus be ten times greater than that of a fission bomb, that is, about ten miles for severe damage.

Against the background of Nature, atomic weapons are small. An average local thunderstorm releases as much energy as a plutonium bomb; a hurricane or an earthquake, a million times as much. Nevertheless, they are frightful weapons, capable of inflicting terrible destruction and wholesale death.

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* From a lecture on Atomic Weapons by Prof. O. R. Frisch reported in *Nature*, March 10, p. 477, 1954.

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# SYMPOSIUM ON NON-FERROUS METAL INDUSTRY IN INDIA

WITH the object of focussing attention on the present state of Indian non-ferrous metal industry and discussing ways and means for stimulating its growth to meet present and future requirements, a symposium on the above subject was held during 1-3 February 1954, under the auspices of the National Metallurgical Laboratory of India, Jamshedpur. 36 technical papers received from India and abroad were presented and discussed in the 3-day session by the participating delegates, which represented industrial organisations, Government and educational institutions, C.S.I.R., besides foreign delegates from abroad.

Dr. N. P. Allen, of the Metallurgy Division, National Physical Laboratory, Teddington, England, also participated in the symposium and gave an illuminating lecture on "Titanium and Zirconium" on the opening day of the technical session, wherein he discussed at considerable length Indian resources of these metals in the general context of world reserves, their physical characteristics in relation to

their multifarious applications and indicated the trends of researches under way in U.K. on these two important metals and their alloys.

Mr. E. H. Bucknall, Director, National Metallurgical Laboratory, delivered an address on "High Temperature Materials" in the course of which he discussed the phenomenon of creep and referred to his researches at the National Physical Laboratory (U.K.) on age-hardening alloys with improved creep resistances. He further put forth the requirements of high temperature materials required in gas turbines, combustion chambers, stator blades or nozzle guide vanes, turbine discs and rotor blades, etc. The lecture was profusely illustrated with slides.

The industrial data and technical know-how gained and discussed at the symposium, should no doubt serve to bring into lime-light our valuable non-ferrous mineral reserves and requirements, and to develop possible lines of expansion of this vitally important national industry in many fields.

## UNION CATALOGUE OF LEARNED PERIODICALS*

THE Catalogue, prepared by Dr. S. R. Ranganathan and his assistants, is the first volume of the *Union Catalogue* and contains the names of several periodicals in Natural Sciences which are found in the libraries of Burma, Ceylon, India, Indonesia and Malaya. Volume 2 (*Humanities and Social Sciences*) and Volume 3 (*Generalia and Cumulative Index*) are to follow. This is the first attempt in this part of the globe to compile such a valuable and useful catalogue. Two other outstanding companion volumes of this type are the *Union list of serials in libraries of the United States and Canada and the World List of Scientific Periodicals* for America and Great Britain respectively. And this is again the first attempt at a classified arrangement (with an alphabetical index) of the periodicals mentioned in the catalogue, while the other two list the names in one alphabetic sequence under the first word or catch word. The advantages of a classified arrangement are, of late, much appreciated and this is, therefore, a step taken in the right direction to satisfy the needs of librarians, scholars and research workers.

The catalogue lists of the periodicals available in 210 libraries in South-Asia. Details regarding volume numbers and/or years, whether current or defunct, and where available, are furnished in a double column as in the *Union list* in a most appropriate manner. Dr. Ranganathan deserves to be congratulated on the production of this monumental work (in these days of financial stringency for libraries) which is indispensable for reference in any library. The volume is neatly printed and attractively got up.

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* *Union Catalogue of Learned Periodical Publications in South Asia*, Vol. I. (*Physical and Biological Sciences*). By S. R. Ranganathan and others. (Indian Library Association), 1953. 11 × 9. Pp. 390. Price Rs. 25.

Some small mistakes are found here and there. "Libraries", "periodical", "tuberculosis" are misspelt on pp. 15, 349, 339 respectively. In the index portion "Bengal" should not have been indented. "Allmanna", "Andhra", "Aneos", "Bilotermanns" do not come in their proper places alphabetically.

Even Dr. Ranganathan's example "Annals Math Statistics B 28 m 73, N" given on page 20, is indexed as "Annals Mathematical Statist B 28 m 73, M 1" on page 326. "Journal fur die reine und angewandte mathematik" is found in the body, but its familiar name "Crelle's Journal" is not cross-referred.

The following improvements may be made: (1) Instead of giving periodicals defunct in italics, the word (D) may be put against them just as (C) is put against periodicals current. (2) All entries in the body as well as in the index may appear in antique to eliminate the distinction between the current and the defunct periodicals as this information is, after all, required by few. (3) The names of periodicals may be given in full in the index under the first word, not an article; for difficulty is experienced to locate long names if prepositions in them are omitted. (4) Subject entries may be furnished separately as in the British National Bibliography, 1950; for a casual user would observe that "Biology", "Chemistry", "Desert" get two different numbers each. (5) If the periodicals are also numbered as in the *World list* and the number only furnished against each periodical in the index, the user could easily locate the periodical wanted instead of remembering the long colon numbers and searching for them in the body. (6) Lastly, the key to the libraries may also be printed separately and kept in the book at the end so that it can be removed to any place in the classified part to facilitate easy identification of libraries. R. JANARDHANAM.

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## CHEMICAL APPARATUS AND EQUIPMENT CONGRESS AND EXHIBITION, 1955

THE Eleventh Congress and Exhibition of Chemical Apparatus and Equipment— ACHEMA XI—is to be held in Frankfurt-am-Main, during 14-22 May 1955. More than 600 firms from 12 different countries will show both their regular lines and their latest developments in the chemical apparatus and equipment field. The DECHEMA Deutsche Gesellschaft fur chemisches Apparatewesen, Frankfurt-am-Main, West 13, who is responsible for the organization and operation of the ACHEMA XI Congress and Exhibition, has divided this vast field of exhibits into the following main groups: Laboratory Technique and Practice, Measuring Control and Regulating Technique and Practice, Materials, Operation and Production Technique and New Chemical Materials and Products. Numerous pieces of machinery and apparatus in use in science and industry will be shown in operation.

# LETTERS TO THE EDITOR

## FINE STRUCTURE OF X-RAY ABSORPTION SPECTRA IN HOMOPOLAR CRYSTALS

IN this note the dissimilarities in the X-ray absorption fine structures for two elements in the same crystal lattice are discussed theoretically. Kronig[1] qualitatively suggested that the fields round the positive and negative ions in an ionic crystal are different and hence give rise to different fine structures. This idea is presented here in a mathematical form. Stephenson[2] reports that the fine structures in polar crystals are generally similar for the elements present therein, but for homopolar crystals, the two fine structures are completely non-repeatable. The latest reports [of the Wisconsin Conference (1950)] also suggest a similar state of affairs. The work of Prof. Kiestra has revealed the dissimilarities for several polar crystals as well. Stephenson has pointed out typical examples of Cu-Br and Zn-Se.

Mott and Jones[3] have shown that the intensity in an X-ray absorption spectrum can be expressed as

$$I(E) \propto p(E) \cdot N(E) \quad \text{or} \quad \propto E^{3/2} \text{ or } E^{1/2} \tag{1}$$

according as we consider $s$- or $p$- level and use the first or second Brillion zone. For nearly free electrons we have[4]:

$$E = \tfrac{1}{2} \{ E_0 \pm E_n \sqrt{\{ (E_n - E_0)^2 + 4 V_n \bar{V}_n \}} \tag{2}$$

For two ions in the same lattice, all the terms are common except $|V_n|^2$. The wave function for an electron in a NaCl lattice can be written as[5]:

$$\psi_k(r) = \sum_N e^{ik_{R_N}} \phi_N(r_N - R_N) + \sum_C e^{ik_{R_C}} \phi_c(r_c - R_c) \quad (3)$$

Remembering $H(\psi) = E(\psi)$, we can safely conclude that

$$E = E_c + E_N + \Omega \quad (4)$$

*i.e.*, the energy of a conduction zone can be expressed as built up of the contributions due to two ions separately, and the exchange term. For the homopolar crystals the potential energy is[4]:

$$U = \sum_{i,j} \frac{\pm \alpha \epsilon^2}{|R_i - R_j|} + \sum_{i,j} \frac{\epsilon^2}{|r_i - r_j|} + \sum_{i,j} \left( \frac{\pm \alpha \epsilon^2}{R_i} \mp \frac{\epsilon^2}{r_j} \right)$$
$$+ 1 \cdot 058 \frac{\epsilon^2}{r_0} \quad (5)$$

On a careful examination of this expression, one can see that if

$$-\sum_j \left( \frac{\epsilon^2}{r_j} \right) = \frac{\epsilon^2}{r_0} (1 \cdot 058) \quad (6)$$

holds, for a certain value of $j$, the fourth term vanishes for a negative ion, but not for a positive ion. Similarly,

$$\sum_{i,j} \frac{-\alpha \epsilon^2}{|R_i - R_j|} + \sum_{i,j} \frac{\epsilon^2}{|r_i - r_j|} \mp \sum_{i,j} \frac{+\alpha \epsilon^2}{|R_i - R_j|}$$
$$+ \sum_{i,j} \frac{\epsilon^2}{|r_i - r_j|} \quad (7)$$

*i.e.*, the variation of potential energy for a positive ion is quite different than that for a negative ion and because[6]

$$I_{\alpha\beta\gamma} = H_{\alpha\beta\gamma} |V_{\alpha\beta\gamma}|^2 \quad (8)$$

where $\alpha$, $\beta$, $\gamma$ are the Miller indices for a plane of discontinuity, and

$$W = \frac{n^2 h^2}{8 m d^2} (\alpha^2 + \beta^2 + \gamma^2), \quad n = 1, 2, 3 \quad (9)$$

is the energy in e.v. for $I_{\alpha\beta\gamma}$, we can see that $I_{\alpha\beta\gamma}$ can become small or vanish only for one type of ions and may exist as such for the other.

An alternate hypothesis can be put forward.[7] If one of the ions present in the lattice is capable of giving rise to white absorption line by the creation of new excitation states below the conduction zones as a result of interaction of the positive K-hole and the lattice field, the fine structures near the absorption edge of this ion will differ from that of the other ion not capable of giving a white line. The excited states are formed for all sorts of ions, but the white line is given only if allowed by the selection rules.

The author thanks Dr. G. B. Deodhar for his interest in the discussions.

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## THE FORCE CONSTANTS FOR THE NON-PLANAR VIBRATIONS OF 1, 3, 5 TRIMETHYL BENZENE

NORMAL co-ordinate analysis has been carried out to determine the non-planar valence force constants of 1, 3, 5 trimethyl benzene based on the frequency assignment of Pitzer and Scott[1] and utilising the set of force constants obtained in the normal co-ordinate treatment for the non-planar vibrations of benzene by Miller and Crawford.[2] As far as the author is aware, these force constants have not been determined previously.

This molecule belongs to the point group $D_{3h}$. The 9 non-planar vibrations are divided into two types $3 A_2'' + 3 E''$, the latter being doubly degenerate. The lowest $A_2''$ fundamental has not been recorded in the infra-red. But two weak Raman lines 145 cm.$^{-1}$ and 182 cm.$^{-1}$ are stated by Pitzer and Scott[1] (p. 820) to have been observed by two previous investigators. Pitzer and Scott have assigned 182 cm.$^{-1}$ to $A_2''$ type as this satisfies the Tellar and Redlich product rule better than the other frequency, 145 cm.$^{-1}$. The present calculations confirm the above assignment.

The elements[3] of the P.E. matrix involve the combinations of valence force constants $\frac{1}{2} H + h_m$ and $2\bar{a}_0 + \bar{a}_p$ in $A_2''$ type and $H - h_m$ and $2\bar{a}_0 - 2\bar{a}_p$ in $E''$ type, where $H =$ the diagonal methyl wagging constant, $h_m =$ the interaction constant between two methyl bendings, $\bar{a}_0 =$ the interaction constant between methyl bending and hydrogen bending (H in *ortho* position), and $\bar{a}_p =$ the interaction constant between methyl bending and hydrogen bending (H in *para* position). These are evaluated with the help of two completely assigned frequencies (690 cm.$^{-1}$ and 840 cm.$^{-1}$ of $A_2''$; 275 cm.$^{-1}$ and 847 cm.$^{-1}$ of $E''$) of each of the above two types. Two sets of force constants are obtained

in each type on account of the quadratic nature of the secular equation. Using both the sets of the force constants thus obtained, the remaining frequency is calculated in each type. The results are given in Table I.

TABLE I

| Type of vibration | | Force constants $(F \times 10^{-5}$ dynes/cm.) | |
|---|---|---|---|
| | | I | II |
| A″ | $\frac{1}{2}H + h_m$ | 0·34092 | 0·29785 |
| | $2\bar{a}_0 + \bar{a}_p$ | 0·85021 | 0·03602 |
| | Frequency calc. | 1286 cm.$^{-1}$ | 179 cm.$^{-1}$ |
| E″ | $H - h_m$ | 0·32016 | 0·27568 |
| | $2\bar{a}_0 - 2\bar{a}_p$ | −0·46066 | −0·19055 |
| | Frequency calc. | 771 cm.$^{-1}$ | 561 cm.$^{-1}$ |

The value 439 cm.$^{-1}$ suggested by Pitzer and Scott from a comparison with the frequencies of $m$-xylene agrees with neither of the values obtained in the E″ type of vibration. But from a comparison with the frequencies of 1, 3, 5 trifluorobenzene it may be seen that 179 cm.$^{-1}$ of $A_2″$ and 561 cm.$^{-1}$ of E″ calculated by the author compare well with the corresponding frequencies 214 cm.$^{-1}$ of $A_2″$ and 595 cm.$^{-1}$ of E″ observed by Nielsen[4] and confirmed recently by Ferguson.[3] A reinvestigation of the infrared and Raman spectra of the molecule is desirable to establish these fundamentals.

The numerical values of the four non-planar valence force constants are $H = 0·38235$, $h_m = 0·10667$, $\bar{a} = −0·01975$, and $\bar{a}_p = 0·07552$ ($\times 10^5$ dynes/cm.).

Full details of the paper will be published elsewhere.

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## ON THE NERINEA BEDS OF THE PONDICHERRY CRETACEOUS OF S. INDIA*

CRETACEOUS rocks of the Pondicherry area were first studied in detail by Blanford[1] and Stoliczka.[2] Subsequent collections made by Warth[3] were studied by Kossmat[4] who established the following three divisions :

3. Nerinea beds        Danian
2. Trigonoarca beds    }
1. Valudavur beds      }   Upper Senonian

Kossmat regarded the Nerinea beds to be of Danian age on account of the presence of *Hercoglossa danica,* and correlated them with the Niniyur beds of the Trichinopoly area. Vredenburg[5] thought them to be the equivalents of *Cardita beaumonti* beds of Baluchistan. Lemoine and Furon[6] recorded the presence of Laki (*Assilina granulosa*) and Upper Eocene (*Discocyclina pratti*) horizons in bore-holes near Pondicherry. L. Rama Rao[7] noted the presence of *Nummulites* and *Discocyclina* in one of the limestones from this area and assigned an Eocene age for the same.

The present author[8] had reported in 1951 foraminiferal genera *Siderolites* and *Globotruncana* from this area. Subsequent detailed work has shown that the shell limestone containing the above genera belongs to the Trigonoarca beds and not to the Valudavur beds.

The upper part of the Trigonoarca beds contain the foraminiferal genus *Siderolites,* which is strictly Mæstrichtian in age. These beds are the equivalents of the *Lepidorbitoides* bearing beds of the Ariyalur stage of the Trichinopoly District.

Between the Trigonoarca beds and the overlying Nerinea beds there is no hiatus and the latter are Danian in age, like the type area in Holland where the Danian overlies the Mæstrichtian without a break. A careful examination of the canal section near village Mettuveli, where both Trigonoarca and the Nerinea beds occur, shows that sedimentation has been continuous.

Kossmat figured two species of foraminifera from the Nerinea beds, one as *Amphistegina* and another as *Orbitoides.* An examination by the author shows that Kossmat's *Amphistegina* is an *Operculinoides,* a genus very similar to *Nummulites* but with a paucispiral coiling. His *Orbitoides* is one of the four species of *Discocyclina* that the author has recognised in these beds. The foraminifera which L. Rama Rao recognised from the so-called Eocene bed of the Pondicherry area, are from the Nerinea beds and his *Nummulites* is the same as the form that has now been recognised as *Operculinoides* and the *Discocyclina* he has figured are identical with author's species. The *Discocyclina* consist of four species and their equatorial chambers show them to be very primitive. There is nothing in this fauna which suggests a comparison with the Ranikot beds. On the other hand, field evidences show that the relationship between the Trigonoarca beds and

the Nerinea beds is the same as that of the Ariyalur and the Niniyur beds in the Trichinopoly District.    Both the Nerinea and the Niniyur beds follow without unconformity, beds which on foraminiferal evidence can be definitely dated as Mæstrichtian. The absence of *Operculinoides* and *Discocyclina* in the Niniyur beds may be due to facies difference.

The record of *Nummulites* and *Discocyclina* go back to the Danian in other parts of the world, and in the Danian of Western Georgia, U.S.S.R.[10] these forms occur together.    The Pondicherry forms are small and primitive and canont be identified with any known Eocene species. Both the field and faunal evidences[11] suggest that Kossmat's classification of the beds as Danian is correct.

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## MANGANIFEROUS MICAS FROM KANTAKAPALLE AREA, VISAKHAPATNAM DISTRICT*

In the manganese pits at Kantakapalle (Long. 83° 14½′, Lat. 17° 57′) pegmatite veins carry as desseminations small, thin booklets of copper red mica. Microsections reveal the following characters.

Body colour : shades of reddish brown. Pleochroism weak in the shades of reddish brown colour. Shows straight extinction. Alteration to spongy opaque mass (Hydrated manganese oxide ?) is observed.   It is biaxial and is negative in sign. Refractive index (mean) $= 1 \cdot 59 \pm 0 \cdot 01$, $2 V = -22°$.

Chemical tests reveal the presence of manganese in the constitution of the mineral. It

is associated with quartz and orthoclase (which is highly altered) with manganese ore as an accessory. This manganiferous mica shows close resemblance to the phengites as can be noticed from the following table.[1]

| | Muscovite | Ferro-muscovite | Picro-phengite | Ferri-phengite | Mica under study |
|---|---|---|---|---|---|
| 2V | −47° | −38° | −25° | −15° | −22° |
| Optic Plane | ⊥010 | ⊥010 | ⊥010 | ∥010 | ⊥010 |
| $N_x$ | 1·552 | .. | .. | .. | .. |
| $N_y$ | 1·582 | 1·66 | 1·59 | 1·61 | 1·59±0·01 |
| $N_z$ | 1·588 | .. | .. | .. | .. |
| $N_z - N_x$ | 0·036 | 0·04 | 0·04 | 0·04 | .. |

The manganese micas associated with the manganese ores were divided by Fermor[2] into two broad groups according to their colour. The pink and rose red micas were grouped under Alurgites (related to muscovites) and brown micas were grouped under Manganophyllites (related to biotites).

Manganiferous micas with very low optic axial angles ($2 E = 0\text{-}4°$) were reported from Central Province by Bilgrami[3] which Fermor[2b] was inclined to place in the manganophyllite group than in the alurgite group. The mica described above is related to the Alurgites (manganiferous phengites).

It is surmised that the manganese mica is a result of the infusion of pegmatite veins into the ore-body and is formed by the replacement of part of iron in phengites by manganese during the process, similar to the genesis of manganese micas in Central Provinces.    Alurgites were not described earlier from the manganese formations of Visakhapatnam District.

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# NATURE OF THE FINE BANDINGS IN THE DHARWAR SHALES

A STRIKING feature of some of the shales near Dharwar is the fine bandings they exhibit. The author recently examined these shales in detail with special reference to the mode of origin of these bandings in view of the suggestion made by C. S. Pichamuthu[1] that they may be of the nature of 'glacial varves'.

Such banded shales are very well exposed in the cuttings near the Dharwar Railway Station. Although the bands are usually uniform, consistent and straight, they sometimes show broad festoon-like curves but maintaining the parallelism of the bands. Each band is a 'varve-like' couplet with a coarser basal part grading upwards to a finer texture. The finer portion of a band ends abruptly against the coarser part of the next succeeding couplet. The thickness of the lower and upper part of each couplet was measured in a section showing a series of 17 such couplets and the results are shown graphically (Fig. 1-A) following the method of
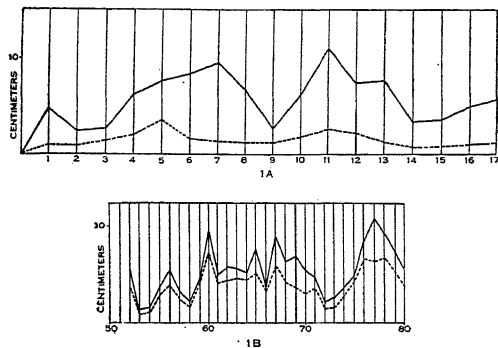


FIG. 1. Thickness variation diagrams of : (A) the banded Dharwar shales ; (B) the varved pre-Cambrian slates of north-western Ontario.

De Geer.[2] For purposes of comparison, a similar graph drawn by Pettijohn[3] for the varved clays of north-west Ontario is given (Fig. 1-B).

An examination of Fig. 1-A reveals the variation in thickness from layer to layer, the average being 5-6 cm. The fluctuation in total thickness is largely a function of the fluctuation of the coarser fraction, the thickness of the finer fraction being nearly uniform. These features indicate an annual control in the deposition of these banded rocks.

Such finely banded shales have been reported by Sederholm[4] and Eskola[5] from the Archæans of Finland, and by Pettijohn[6] from the pre-Cambrians of north-western Ontario.

According to these authors, varved sediments are caused by seasonal control of deposition under a cold climate though not glacial. In the present case, the complete absence of tillites in the area, the abundance of red shales and their association with the banded hæmatite quartzites preclude the possibility of a cold climate; but the bandings indicate a seasonal control in their mode of formation. The author's[7] detailed study of the banded shales and the associated rocks of this area by sedimentary petrographic methods has shown that they are all marine sediments formed under a warm climate with alternating wet and dry seasons. In this connection it is interesting to note that Shrock[8] has also recently stated, "It now seems to be generally accepted that varved sediments represent sequences of annual deposits made in quiet waters of either fresh or brackish waters". According to Zeuner[9] also there are laminated deposits "which look exactly like glacial varves although they were formed under the influence of some other seasonal rhythm, such as wet and dry seasons, or alternation of chemical deposition of carbonate with biological deposition of plankton". Thus, in the light of these recent studies, it may be inferred that the fine bandings in the Dharwar shales were formed by deposition in quiet marine waters under a warm climate, and caused by an annual control of alternating wet and dry seasons.

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## EFFECT OF DEFICIENCY OF THIAMINE AND PANTOTHENIC ACID ON THE SYNTHESIS OF ACETYLCHOLINE IN RATS

THE presence of acetylcholine at the nerve endings and also in other tissues has attracted the attention of a group of workers in this field and researches have been directed in different laboratories to explore the mechanism of its synthesis. Previous work, mostly *in vitro*, suggest that two important vitamins like thiamine and pantothenic acid play an important role in the above synthetic process—thiamine as co-carboxylase being involved in the formation of 'acetate' group by oxidative decarboxylation of pyruvic acid[1-5] and pantothenic acid in the form of co-enzyme A participating in the acetylation of choline by activating the 'COOH' group.[6,7]

There is, however, meagre evidence to show how far the deficiency of the above vitamins in the diets of the animals affects the biosynthesis of acetylcholine in their tissues. The present investigation aims to study this aspect of acetylcholine synthesis in rat tissues.

Experiments were conducted on young rats of 50-60 g. body weight and divided into three groups of ten each. Rats of Group A were fed on a purified diet of the following percentage composition : sucrose, 65; casein, 20; salt mixture (McCollum & Davis), 4; groundnut oil, 8; cod liver oil, 2; vitamin mixture, 1.

The vitamin mixture for normal rats of Group A contained crysttalline biotin, 30 mg.; thiamine hydrochloride, 0·5 g.; riboflavine, 0·25 g.; pyridoxine hydrochloride, 0·2 g.; calcium pantothenate, 1 g.; nicotinic acid, 1 g.; folic acid, 0·05 g.; vitamin K, 0·1 g.; inositol, 50 g.; and *para*-aminobenzoic acid, 10 g.—made up to 1,000 g. with powdered sucrose, while for Group B animals, thiamine and for Group C animals, pantothenic acid were omitted from the above mixture, in order to produce the respective vitamin deficiency. The rats were fed *ad libitum* for a period of 6-8 weeks till the deficiency symptoms markedly developed in Group B and C animals. The rats of all the three groups were then killed and their brain, liver and heart were transferred into eserinised tyroide solution after promptly weighing. The tissues were then sliced, ground, ice-freezed, and after centrifugation, the supernatant fluid removed and used for acetylcholine estimation according to the technique of Feldberg[8] in a Leech muscle apparatus by comparing the contractions due to these extracts against those obtained by pure acetylcholine.

TABLE I

*Showing the acetylcholine content in various tissues of experimental rats*

| Batch | | Ach. content in μg./g. of tissue | | |
|---|---|---|---|---|
| | | Heart | Brain | Liver |
| Group A | .. | 4·65 | 2·90 | 6·10 |
| Group B | .. | 2·08 | 1·40 | 0·23 |
| Group C | .. | 3·06 | 1·77 | 1·00 |

Group A—Control ; Group B—Thiamine deficient ; Group C—Pantothenic acid deficient.

The average values as presented in Table I seem to indicate that both thiamine and pantothenic acid deficiencies produce an appreciable decrease in the acetylcholine content in the above tissues. In both the cases, the decrease was marked in the liver tissues as compared to brain and heart. While comparing the effect of the deficiency of the above vitamins separately, it appears that in all the tissues pantothenic acid deficiency produces lesser effect than thiamine deficiency and this may be explained as due to the presence of thiamine in the pantothenic acid deficient diet, which by virtue of its inhibitory action on cholinesterase as observed by one of the authors and reported elsewhere,[9] might help in the conservation of acetylcholine synthesised under the above dietary conditions.

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# FORMATION OF RED PIGMENT BY A MUTANT OF *PENICILLUM NOTATUM*

PIGMENTATION in Penicillia cultures is a common occurrence.[1-10] The purpose of the present communication is to report a new type of blood-red diffusible pigment formed by the mutagenic strain of *P. notatum*.

A mutant of *P. notatum* CFTRI 1013, was grown in 250 ml. conical flasks containing 50 ml. of the dextrose-peptone broth (dextrose 40 g., peptone 10 g./1,000 ml. pH 5·0) at room temperature (26-27° C.) for the period of 30 days. The inoculation was made with a 7-days-old culture grown on dextrose-peptone agar slant where pigment formation had been found developing profusely well in an earlier experiment. The mould grew quickly and within 2-3 days cultural fluid turned to a red-coloured solution. The pigment concentration was measured in a Lovibond's Tintometer.

TABLE I

*Intensity of the pigment on various days of mould growth*

| Period of incubation days | Lovibond units | |
|---|---|---|
| | R | Y |
| 0 | 0·2 | 1·0 |
| 1 | 0·8 | 1·2 |
| 2 | 3·0 | 3·3 |
| 3 | 10·0 | 9·0 |
| 4 | 27·0 | 13·0 |
| 5 | 60·0 | 33·0 |
| 6 | 72·0 | 30·0 |
| 7 | 80·0 | 34·0 |
| 10 | 100·0 | 43·0 |
| 15 | 198·0 | 110·0 |
| 20 | 230·0 | 120·0 |
| 30 | 228·0 | 120·0 |

The data (see Table I) reveal that the mutant of *Penicillium notatum* secretes large concentrations of blood-red pigment. The maximum production of the pigment is obtained only after 20 days of incubation at room temperature. The pigment formation could be accelerated by providing adequate aeration and agitation in the culture medium. The mould was grown under submerged conditions in 4-litre wide-bottomed culture flasks containing 500 ml. of the dextrose broth for a period of 8 days and the metabolism solution was completely dried in shallow layers in a current of warm air (40° C.). The crude pigment obtained in this manner was found soluble in water, alcohol, acetone and pyridine but insoluble in ether, benzene and ethyl acetate. Acid and alkali neither changed the colour of the solution nor precipitated the pigment. The red pigment was adsorbed on activated charcoal from which it was partially eluted with ethyl alcohol. The pigment could not be crystallised. Further studies are in progress.

Microbiology & Sanitation
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# RIBOFLAVIN IN GRAM SEEDLINGS

THE present work refers to the effect of light on the biosynthesis of riboflavin and its distribution in the different parts of the gram seedlings. Seeds of the Chafa variety of Gram (*Cicer arietinum*) were germinated in bright sunlight, diffused daylight and total darkness in sterilised pure white quartz and periodically assayed for riboflavin content by the microbiological technique. Maximum synthesis takes place upto the 4th or 5th day, when the riboflavin content of the seedlings more than doubles that at the beginning. Light seems to have an inhibiting effect. Thus, the riboflavin content falls from 94·3 $\mu$g. per 100 seeds in total darkness to 80·0 $\mu$g. in diffused daylight and 69·4 $\mu$g. in bright sunlight, during 4 days of germination. Gustafson[1] has pointed out that in the absence of chlorophyll, plants grown in the dark have more riboflavin than those grown in light, probably due to the destructive action of light on riboflavin.

The distribution of riboflavin in the different parts of gram seedlings 24 hours and 96 hours after germination are given in Table I.

## TABLE I
*Riboflavin in μg. per 100 seeds**

| Region | 24 hours | 96 hours |
|---|---|---|
| Cotyledons .. | 39·1 (252)* | 53·3 (463)* |
| Plumule .. | .. | 20·1 (1760)* |
| Radicle .. | 9·4 (1709)* | 22·1 (1771)* |
| Total .. | 48·5 | 95·5 |

* μg. riboflavin per 100 g. of dry weight of the part.

Most of the increase in riboflavin content takes place in the plumule and the radicle and their concentration of riboflavin is considerably higher than that of the cotyledons. It was also found that if germination is arrested on the first day by removing the radicle, the remaining portion of the seeds is not able to synthesise riboflavin to the same extent.

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## STUDIES IN DIHYDROTRIAZINES

EXTENSIVE metabolic studies[2,3,4] with proguanil (paludrine) both in man and animals have led to the isolation of an inactive triazine[1,3,4] (I) and another isomeric dihydrotriazine (II; where R = chloro and X = Y = methyl) several times more active than the parent drug when tested against avian malarials.[2,3,6] Compounds of type (II) have since been synthesized with a view to test their antimalarial activity.[2,5,6]



(I)

Inactive triazine



(II)
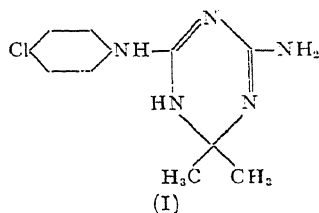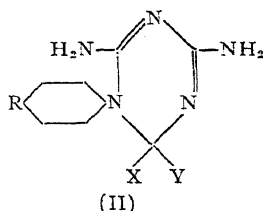
Active dihydrotriazine

R = halogen, alkyl, alkoxy, etc.

X = Y = alkyl (same or different)

Previously studies on aryl-alkyl-biguanides[8] had revealed high antimalarial activity of bromobuanide[7] (p-bromo-phenyl analogue of proguanil). A hypothetical metabolite of bromoguanide, *viz.*, 1-p-bromophenyl-2 : 4-diamino-6 : 6-dihydro-1 : 3 : 5-triazine (type II, R = bromo ; X = Y = methyl) has now been synthesized and characterized as monohydrated hydrochloride, m.p. 203-04° C. (Found: N, 20·28, 20·20. $C_{11}H_{15}N_5ClBr$, $H_2O$ requires N, 19·97 per cent.). This compound was found to be 32 times as active as proguanil and twice as potent as proguanil metabolite (II; R = chloro and X = Y = methyl) when tested against *P. gallinaceum*. On the other hand, 1-p-anisyl-2 : 4-diamino-6 : 6-dimethyl-1 : 6-dihydro-1 : 3 : 5-triazine hydrochloride m.p. 215° C. (Found: N, 24·31, 24·24. $C_{12}H_{18}N_5OCl$, $H_2O$ requires N 24·6 per cent.) and 1-p-toluidino-2 : 4-diamino-6 : 6-methylethyl-1 : 6-dihydro-1 : 3 : 5-triazine hydrochloride monohydrate, m.p. 210° C. (Found: C, 52·1, H, 7·6, N, 22·94. $C_{13}H_{20}N_5Cl$, $H_2O$ requires C, 52·1, H, 7·3, N, 23·4 per cent.) were only moderately active. A number of dihydrotriazines of type (II) are being investigated and it appears that antimalarial activity in case of these compounds usually runs parallel to those of the corresponding $N^1$-aryl-$N^5$-alkyl-biguanides, although generally of a higher order.

The above dihydrotriazines (type II) in the form of their hydrochlorides were prepared according to the procedure of Modest *et al.*[6] 6-Methoxy-8-aminoquinoline and trihalogen-substituted anilines did not furnish the corresponding dihydrotriazines probably due to poor solubilities of their hydrochlorides.

Details of this work will be published later.

Chemistry Laboratory,        H. L. BAMI.
Malaria Institute of India,
Delhi-8, *December* 18, 1953.

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# THE AMINO ACIDS IN THE LEAF OF *AZADIRECTA INDICA* (MELIA)

THE presence of free amino acids in various parts of plants has been reported.[1] The leaf of *Azadirecta indica* (melia) has been studied for its free amino acids using the chromatographic technique.

The leaf-extract was prepared as follows : about 10 g. of the fresh leaf, accurately weighed, was mascerated with about 20 ml. of water and filtered through a muslin cloth to remove the tissue debris. The filtrate was centrifuged, and transferred to a beaker. Enough absolute alcohol was added to make the alcohol concentration about 80 per cent. The beaker was kept overnight in a refrigerator. The protein was completely precipitated and filtered off. The filtrate was evaporated under reduced pressure to a small volume (9 ml.). The extract was clear and almost free from pigments. It was shaken with chloroform to remove all traces of pigment.

Total N was determined in a sample of fresh leaves by the Kjeldahl method. Amino acid N was determined with the leaf-extract prepared as above. Amino acid analysis was done using the circular-paper chromatographic method of Giri and Rao[2] as modified in this laboratory.[3] 50 $\mu$l. of the extract was used for spotting. Seven bands were obtained on the chromatogram and were confirmed as cystine, aspartic acid, glutamic acid, alanine, proline, tyrosine and glutamine. Quantitative analysis was done by the method of Giri *et al.*[4] Individual bands were cut out and the colour extracted with 10 ml. of 75 per cent. alcohol containing 0·05 mg. $CuSO_4$. $5 H_2O$ per ml. Readings for the intensities of colour of the alcoholic extract were obtained using a photoelectric colorimeter.

The results are reported below :

| | | |
|---|---|---|
| Total N is the leaf | .. | 952 mg. % |
| Free Amino acid N in leaf (By experiment) | .. | 13·356 mg. % |
| Free Amino acid N in leaf | .. | 13·310 mg. % |

(by calculation from column 2 of table below)

| Amino acid | | mg. % | Per cent. of free amino N |
|---|---|---|---|
| Glutamic acid | .. | 73·30 | 55·85 |
| Tyrosine | .. | 31·50 | 19·31 |
| Aspartic acid | .. | 15·48 | 14·51 |
| Alanine | .. | 6·43 | 7·56 |
| Proline | .. | 3·98 | 3·62 |
| Glutamine | .. | about 1 | about 1 |
| Cystine | .. | ,, | ,, |

The high concentration of free glutamic acid in the leaf suggests that the $\alpha$-keto acids formed during carbohydrate metabolism undergo transamination at the expense of glutamic acid to form new amino acids. The utilization of glutamic acid and the consequent fall in its concentration leads to the breakdown of more glutamine which gives rise to glutamic acid and ammonia which can be employed in the direct amination of more of the $\alpha$-keto acids. Also the free ammonia can be used to synthesise more glutamic acid from $\alpha$-keto glutaric acid, an intermediate in the oxidative breakdown of the carbohydrates. Glutamic acid and glutamine seem, therefore, to fulfil in this plant, a part parallel to that of aspartic acid and asparagine in many other plants.

I wish to thank Dr. S. C. Devadatta and Dr. K. V. Giri for their keen interest in the work.

Dept. of Biochemistry,     K. DAKSHINAMURTI.
Christian Medical College,
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# EFFECT OF 2, 4-DICHLOROPHENOXY ACETIC ACID, ON *SOLANUM MELONGENA*, L.

STUDIES on the effect of 2, 4-Dichlorophenoxy acetic acid as a plant growth regulator applied in the manner and concentrations mentioned in Table I, to induce parthenocarpy and to increase fruitset in brinjal *Solanum melongena* L. gave the following results. To the knowledge of the authors, this is the first time, 2, 4-D has been experimented with for this purpose with the brinjal.

(*i*) All the treatments with 2, 4-D induced 100 per cent. parthenocarpy in all fruits, which set as a result of application of the plant growth-regulator. (*ii*) All the treatments with 2, 4-D showed increased fruitset over the control. The highest increase was, however, shown by 2, 4-D applied as paste in 0·0025 per cent. concentration, giving 60 per cent. of fruitset compared to 27 per cent. in control. (*iii*) The average weight and volume of fruits in every treatment with 2, 4-D showed a decrease over the control, but the total yields obtained

TABLE I

| Method of application | Conc. of 2, 4-D | Particulars regarding mature fruits | | | | Deviation from normal | |
|---|---|---|---|---|---|---|---|
| | | %age of set | Av. days taken for maturity | Av. wt. in g. | Av. vol. in c.c. | in wt. g. | in vol. c.c. |
| As paste | 0·0025% | 60 | 36 | 60·1 | 81·5 | +583 | +835·8 |
| | 0·005% | 56 | 34 | 56·5 | 75·2 | +362 | +496·4 |
| | 0·01% | 50 | 35 | 55·4 | 72·4 | +165 | +200·8 |
| As water sprays | 2 P.P.M. | 58 | 38 | 62·0 | 80·5 | +578 | +725·3 |
| | 5 P.P.M. | 56 | 36 | 58·5 | 73·7 | +418 | +454·4 |
| | 10 P.P.M. | 52 | 34 | 59·5 | 79·3 | +327 | +452·6 |
| As talc. dust | 0·0025% | 46 | 41 | 45·4 | 58·2 | −177 | −270·6 |
| | 0·005% | 42 | 39 | 43·3 | 54·3 | −310 | −468·9 |
| | 0·01% | 40 | 38 | 44·5 | 57·2 | −330 | −465·2 |
| Control | Non-treated | 27 | 43 | 90·3 | 119·2 | .. | .. |

except in the case of the talc dust, as a result of increased fruitset, not only compensated for the loss in individual weight and volume, but also showed very significant increase over the control. 2, 4-D as a plant growth-regulator was however not able to induce and to stimulate any fruit development in the true short-styled flowers, which even normally produced no fruit. (*iv*) In all the treatments with 2, 4-D, the average number of days taken for maturity was less than in the control, the decrease in period ranging from 2-9 days. (*v*) In all the treatments with 2, 4-D, the apical end of the fruit terminated in a point and this was more prominent in the case of treatment with lanolin paste. Such pointedness in other fruits as a result of application of plant growth-regulators has been cited by other workers such as Krishnamurthi.[1] (*vi*) The partheno-carpic fruits showed in general some increase in thickness of exocarp; with the talc dust, however (0·005 per cent.), there was no increase in thickness of exocarp. The thickness of exocarp was in no case such as to interfere with the quality of the fruit, as seen from cooking tests.

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Annamalainagar,      D. SUBRAMANIAN.
*December* 19, 1953.

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## RELAXATION OF UNSTRIATED MUSCLE AND DENATURATION OF PROTEINS

ACCORDING to modern views, denaturation consists of an alteration of the specific internal structure of the protein wherein the closely folded peptide chains unfold.[1] Similarly, the contraction of muscle is supposed to be due to folding of the contractile potein ; so relaxation would be due to unfolding of the muscle proteins. Thus according to these views, the process of relaxation of muscle would be similar to the denaturation of proteins.

The following experiments support the above views. Denaturation of proteins is caused by acids, bases, amides, detergents, guanidine, heat, light and urea. Some of these agents cause unstriated muscle to relax actively, *i.e.*, relaxation of unloaded muscle is produced. Thus acids, bases, urea distilled water sodium, cyanide, sodium pyrophosphate, formamide, acetamide cause active relaxation of the contractile mechanism of unstriated muscle.[2-5] The fact that these substances act on the contractile mechanism, is shown by the observation that their effect, though somewhat diminished, persists after the muscle has been killed by immersion in saline at 50° C. for 10 minutes; unstriated muscle is killed somewhere between 40-50° C. These experiments have been performed on the circular muscle of the stomach of the frog *Rana tigrina*.

Heat is a common agent that denatures proteins. Its effect on unstriated muscle is most

interesting. When circular strips of the stomach muscle of the frog *Rana tigrina* are heated to 50° C., they contract somewhat. Further heating up to 60° C., causes them to actively lengthen by 30-50 per cent. before they are coagulated (12 experiments). Dog's stomach muscle relaxes passively. These experiments throw light both on the process of denaturation and the mechanism of muscular contraction.

Dept. of Physiology, Sunita Inderjit Singh.
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## SOME NEW OBSERVATIONS ON THE CIRCULATORY SYSTEM OF *OPHICEPHALUS STRIATUS* BLOCH. (ACTINOPTERYGII ; PERCOMORPHI)

IT has been known for some time[1-5] that the circulatory system is modified to a large extent in the respiratory organ of air-breathing fishes. The authors find that several features in the afferent branchial system of *Ophicephalus* have either escaped observation or have not been worked out by past workers. The peculiar nature of the origin and distribution of the third and fourth afferent branchial arteries and the location of the ventral aorta in a venous sinus are reported here for the first time.

The ventral aorta after piercing through the anterior wall of the pericardium runs forward along the under-surface of the floor of the pharynx in the mid-ventral line. It remains embedded most of its length in a venous sinus, lying on the floor of the anterior region of the pharynx, which has been named by us as the *Sub-pharyngeal Sinus* (S.Ph.S. in Fig.). It is formed by the union of the single meidan anterior inferior jugular and the first branchial veins in level with the ventral end of the third branchial arch. It extends posteriorly just upto the level of the ventral end of the third branchial arch, and communicates with the right anterior cardinal by the posterior inferior jugular vein. Laterally, the broadest portion of the sinus extends upto the mid-distance between the ventral aorta and the branchial arch. Dorsally, it is bounded by the floor of the pharynx,

while ventral to it lie the pharyngeal muscles. So far as we know, there is no mention of this sinus in any relevent work on the subject.

The ventral aorta extends from the ventral end of the third branchial arch right upto the mid-distance between the first and second branchial arches, where it terminates by dividing into the first pair of afferent branchial arteries. Along its course in level with the ventral end of the second branchial arch, the ventral aorta gives off the second pair of afferent branchial arteries. Just after piercing the pericardium in level with the ventral end of the third branchial arch, the ventral aorta gives off two pairs of arteries. The *anterior or third pair of arteries is in reality the fourth pair of afferent branchial arteries*, which curves posteriorly and runs for a distance (Fig.) dorsally to the
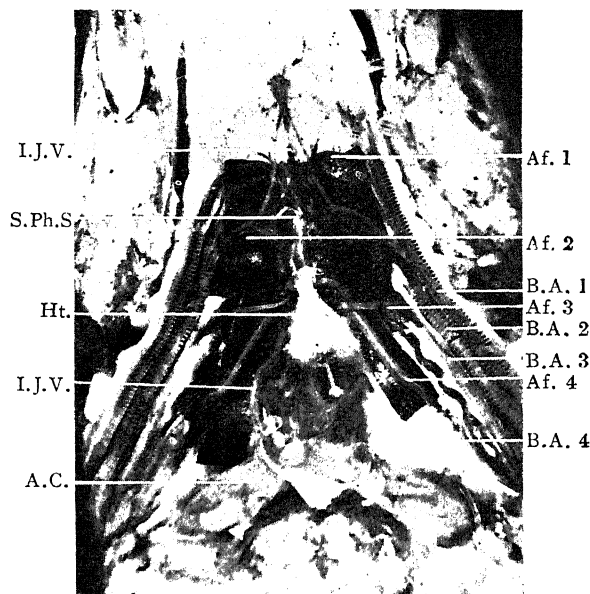


*Ophicephalus striatus* showing circulatory system (respiratory region).

A.C., anterior cardinal ; Af. 1-Af. 4, afferent branchials 1-4 ; B.A. 1-B.A. 4, branchial arches 1-4 ; Ht., heart ; I.J.V., inferior jugular vein ; S.Ph.S., sub-pharyngeal sinus.

third before traversing the fourth gill-arch. The posterior or the fourth pair of arteries is actually the third pair of afferent branchial arteries which runs nearly straight at right angles to the ventral aorta, and passing ventrally to the fourth afferent branchial supplies the third gill-arch (as seen in Fig.). A space is thus left between the third and fourth affer-

ent branchials since the fourth afferent loops back, over and behind the third branchial artery. The peculiar anterior origin of the fourth afferent artery which arises anterior to the third afferent artery is as yet unexplained. It may be that the growth of the air-sac has displaced the artery and thus this peculiarity has arisen in *Ophicephalus*.

Dept. of Zoology,  S. M. Das.
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*December* 17, 1954.

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## CENTRANTHERA NEPALENSIS DON, A NEW ROOT PARASITE

So far sugarcane has been known to be attacked by three angiospermic root-parasites, namely, *Aeginetia indica* Linn. (Orobanchaceœ), and *Striga lutea* Lour. and *S. euphrasioides* Benth. (Scrophulariaceœ). This is the first report of *Centranthera nepalensis* Don (Scrophulariaceœ) as parasitic on roots of sugarcane and two other graminaceous plants.

Hooker[4] recorded *Centranthera* in Australia, Burma, China, Ceylon, India, Java, Malaya and the Philippines. *C. nepalensis* Don was recorded in Bombay State by Cooke[1] and Santapau,[6] in Nepal by Don[2] and in Bihar and Orissa by Haines.[3] Like these authors, Pennell[5] also who dealt with all the species of *Centranthera* in his very comprehensive accounts of *Scrophulariaceœ* in Western Himalayas, made no mention of the parasitic nature of this nor for the matter of fact, of any other species of this genus.

The parasite, which resembled *Striga euphrasioides* Benth. was found growing very close to sugarcane clumps in village Belwa, Bettiah (District Champaran) in October 1952 and was collected as a new species of *Striga*. It was identified subsequently as *Centranthera nepalensis* Don and was found to have definite haustorial contacts with roots of sugarcane. On further observation in the same locality, it was found to parasitise *Cynodon dactylon* Pers. and *Imperata arundinacea* Cyr. In North Bihar, on sugarcane it was met with as frequently as

*S. euphrasioides* Benth. In South Bihar, however, in Kharagpur (District Monghyr), its incidence was fairly high in waterlogged areas.

It is moss-green when young, turning reddish brown on aging. It is 15-22″ in height, stouter than *S. euphrasioides* Benth. and with scarlet-coloured flowers larger than those of all the *Striga* species. Its roots are pale while those of *Striga* are darkish in colour. Seed-coat is straw-coloured with reticulate curved markings while that in *Striga* species is dark (coffee-brown to jet-black) with parallel markings or in straight meshes.

Authors are indebted to Sri. K. L. Khanna for kindly providing facilities for investigation and Sri. S. K. Mukerjee, for his identification of the plant.

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  Station, Pusa (Bihar),  D. Rao.
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## THE ANTIPODALS IN THE FAMILY AMARANTACEAE

In Amarantaceœ, during the formation of the embryo sac cæcum, the antipodals are usually pushed laterally where they persist up to the early stages of the development of embryo. This has been noted in *Digera arvensis*,[1] *Alternanthera sessilis*,[2] *Achyranthes aspera*,[3] *Pupalia lappacea*,[4,5] *Allmania nodiflora*, *Cyathula tomentosa* and *Aerua lanata*.[5] In *Psilostachys sericea*[6] the antipodals degenerate before the secondary elongation of the embryo sac. The number of antipodals has been reported to be three in all the investigated species except *Pupalia lappacea*.[5] "Here," to quote from Kajale,[5] "the antipodals are three in the beginning, but they soon begin to multiply. All of them divide to form a small mass of cells as shown in Figs. 14 *e, g* and *h*. Their total number is variable, but up to 30-40 cells can be commonly counted in the later stages. The cells of the antipodal mass are generally small, full of cytoplasm and without vacuoles, but among

them a few larger cells are also found and these show prominent vacuoles (Fig. 14 *g*)." However, during my investigations of the floral morphology of certain species of the family, I failed to confirm the multiplication of the antipodals in *P. lappacea.* The antipodals no doubt appeared to be more persistent here than in other species, and in many sections I even found them considerably enlarged as in Kajale's Fig. 14 *g*, but in not one instance could I locate the multiplying antipodals. In some cases I did come across a mass of cells as shown in Kajale's Fig. 14 *h* but this was found to be nucellar in origin. It was seen that the strongly curved embryo sac cæcum in the species encloses a central perisperm and *in an oblique section* a few cells of the perisperm are cut off in such a manner that they appear to be embeded in the cavity of the embryo sac. Could it be then that the "antipodal mass" figured by Kajale is also nucellar ? Only a re-checking can possibly settle this point. Till then we may regard *Pupalia lappacea* to be in line with other species of the family in possessing three antipodals but to differ from them in its antipodals becoming much larger and vacuolated during the later stages of embryo sac development.

I am grateful to Prof. P. Maheshwari for the loan of some literature from his personal library, and to Mr. S. L. Chhajlani and Mr. R. N. Kapil for help in various ways.

Dept. of Botany,                    T. S. BAKSHI.
University of Delhi,
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# URINE-INDUCED PARTHENOCARPY IN *LYCOPERSICUM ESCULENTUM* AND *CAPSICUM ANNUUM*

URINES of the cow, bull and buffalo at concentractions of 1 : 500; 1 : 1000 and 1 : 2000 in the case of tomatoes, and 1 : 300; 1 : 400; and 1 : 500 in the case of chillies were applied to substitute fertilization in the development of fruits. A few of the partially opened buds were also emasculated and sprayed with urines. Frequency of spraying when reduced to once a week helped in the formation of fruits as against the dropping off of flowers noticed in tri-weekly sprayings.

TABLE I

*Percentage of parthenocarpic fruits developed under different urine treatments*

| Plant material | Concentration 1 in. | Urine of | | |
| --- | --- | --- | --- | --- |
| | | Cow | Bull | Buffalo |
| Tomato | 500 | 18 | 50 | 42 |
| | 1000 | 33 | 29 | 27 |
| | 2000 | 30 | 22 | .. |
| Chillies | 300 | 53·5 | 51·2 | 56·8 |
| | 400 | 46·3 | 46·2 | 45·8 |
| | 500 | 50·0 | 37·2 | 33·9 |

In tomatoes there is no formation of fruits in 1 : 2000 buffalo urine treatment. Bull and buffalo urines in 1 : 500 concentration show better response than cow urine in an even dose. Weaker doses of cow urine appear to be more effective than of the other two urines in fruit production (Table I).

In chillies 1 : 300 concentration gives a better response in the production of parthenocarpic fruits in all the three urine treatments. Weaker concentrations of bull and buffalo urines give a decreasing percentage of fruits, whereas cow urine in 1 : 500 concentration shows a better response even though at 1 : 400 it gives a low percentage of fruits.

In tomatoes the fruits developed under 1 : 500 concentration treatments in all the three urines appear to be bigger than the control and they contain a few seeds each, obviously because the emasculations were carried out in partially opened buds.

In chillies, perfect seedlessness was ensured by using only the unopened buds for emasculation. Noteworthy increases in size of fruits were achieved in 1 : 300 cow and buffalo urine treatments and 1 : 500 cow and buffalo urine treatments. The increases comprised both the linear dimension and width. In the case of buffalo urine, at 1 : 400 and 1 : 500 concentrations and bull urine at 1 : 300 concentration, the increases were confined to width alone.

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Banaras, *December* 21, 1954.

## POLYEMBRYONY IN *OPUNTIA DILLENII* L.

MANY years ago Englemann[1] figured a seed of *Opuntia tortiopina* as having two embryos. Braun[2] suggested that the four cotyledons which he had noticed in *Opuntia glaucophylla* may indicate a fusion of two embryos and hence polyembryony, though he admits that it may also be explained as fasciation. Hull[3] reported polyembryony in *O. rafinesquii* and Ganong[4] in *Opuntia vulgaris*. Archibald[5] observed the occurrence of nucellar embryos in *O. aurantiaca* but recorded the absence of endosperm. Since this seemed rather unusual, we undertook a study of *O. dillenii*, which is naturalised in many parts of India and was at one time a troublesome weed (recently brought under control by the cochineal insect). Our observations are briefly summarised below.

In the ovules the percentage of sterility is very high and a healthy mature embryo sac is of rare occurrence. In most cases degeneration takes place very quickly, the antipodals degenerating first, then the egg apparatus, and finally the polar nuclei. Nucellar embryony is of frequent occurrence in the ovules which survive and the first signs of formation of such embryos are seen when numerous endosperm nuclei have been formed.

Nucellar embryos originate in the upper half of the embryo sac either from a rather irregular mass of tissue which lies at the micropylar end of the embryo sac; or from the nucellar cells along the wall of the embryo sac (Fig. 1). The cells which give rise to the embryonic masses usually border the embryo sac cavity but sometimes they may be deep-seated. These cells become richly protoplasmic and often contain starch grains. They are soon seen to round off and develop a slightly thicker wall. The first division is usually transverse or oblique (Figs. 1, D–F). Further divisions result in the formation of an embryonic mass (Fig. 1, C) which later projects into the cavity of the embryo sac. As many as six groups of embryonic cells formed in this manner have been observed in a single ovule (Figs. 1, 1 A–F).

There is apparently a keen competition among the embryos and as development proceeds, only one or two persist. In the seeds, we dissected, only one well-developed embryo was seen, sometimes associated with another much smaller embryo having two short and sometimes unequal cotyledons (Figs. 2, 3). In *O. aurantiaca*[5] also only one or rarely two embryos survive in the mature seed though in

*O. vulgaris*[4] there may be more than one smaller embryo along with a large one. When a single embryo occurs in a seed of *O. dillenii* this is usually thicker, and occasionally shows three cotyledons instead of two (Fig. 4) as also reported by Ganong.[6] He offers no explanation but we consider this condition to be the result of an early fusion of two embryonic masses.
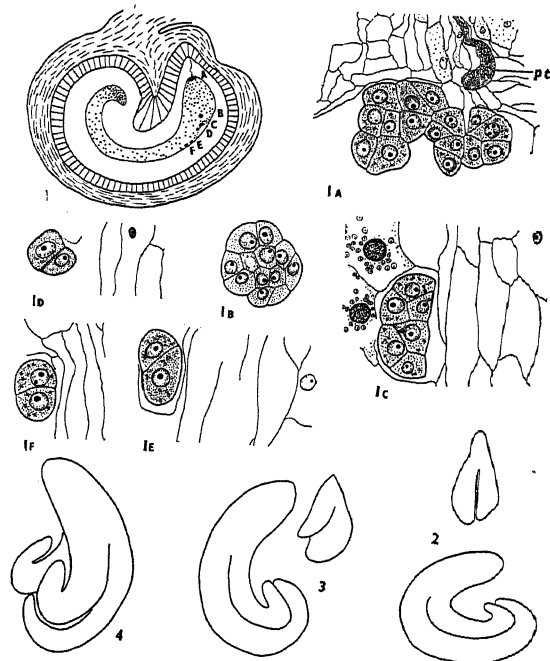


FIG. 1. L.s. ovule showing position of adventive embryos at A—F. The dots in the embryo-sac represent endosperm nuclei, × 11.

FIG. 1 A-F. Magnified view of embryos A-F shown in previous figure, × 275 (*pt.* = pollen tube).

FIGS. 2 and 3. Two pairs of embryos, each obtained from a single seed, × 6.

FIG. 4. Embryo with three (slightly displaced) cotyledons, × 6.

Tiagi[7] has recently reported that there is only one "apparently zygotic" embryo in each embryo sac. While the possibility of the occurrence of a zygotic embryo cannot be ruled out altogether, in our material this did not seem likely. We saw no trace of the zygote in older ovules while adventive embryos were frequent and showed varied positions. Ganong also states that embryos arising at the micropylar end or along the side walls are always of nucellar origin and that the egg is not seen when embryo formation begins.

Archibald[5] reports that in *O. aurantiaca* adventitious embryos are formed from the nucellus without previous pollination, fertilization or the formation of endosperm tissue,

and she therefore considers this case to constitute a new type of adventive embryony. The complete lack of an endosperm would certainly be most remarkable, if true. In *O. dillenii* Tiagi[7] has already reported that there is a free nuclear endosperm consisting of many nuclei and we are able to confirm it. Ganong observed the same in *O. vulgaris* and Huber[8] in over half-a-dozen other genera of the family in addition to *Opuntia*. Ganong observed pollen tubes in the ovules of *O. vulgaris* and also reports fertilization but states that the egg disappears early in the development of the ovule. Pollen tubes have also been observed in *O. dillenii* (Fig. 1, A) but it remains to be seen whether the endosperm is the result of triple fusion or pseudogamous stimulation by the pollen tube.

Grateful thanks are due to Prof. J. Venkateswarlu (Andhra University, Waltair, S. India), who very kindly provided some of the material on which this study is based, and also to the Indian Council of Agricultural Research for a research grant.

Dept. of Botany,                    P. MAHESHWARI.
University of Delhi,                 R. N. CHOPRA.
Delhi-8, India,
*January* 14, 1954.

1. Quoted in Braun.[2]
2. Quoted in Ganong.[4]
3. Quoted in Archibald.[5]
4. Ganong, W. F., *Bot. Gaz.*, 1898, **25**, 221.
5. Archibald, E. E. A., *South Afric. J. Sci.*, 1939, **36**, 195.
6. Ganong, W. F., *Ann. Bot.*, 1898, **12**, 423.
7. Tiagi, V., *Proc. Indian Sci. Congress*, **41**, 143.
8. Huber, J. A., *Monatsschr. deutsch Kakteen-Ges.*, **1** (9), 175.

## BEHAVIOUR OF TAPETAL CELLS DURING MICROSPOROGENESIS OF *ADENANTHERA PAVONINA* LINN.

OUT of the layers of the parietal tissue of the anther, tapetum is of considerable interest as well as physiological significance. Two main types have been recognised, the secretory type and the amœboid type. In the former, cells remain *in situ* without breaking their walls and this type is of common occurrence. In the amœboid type, walls of cells break down and their protoplasts protrude and wander between the sporogenous cells. In *Adenanthera pavonina* (Mimosaceæ), the behaviour of the tapetum appears to be as intermediate between the two types. The innermost layer of the parietal tissue in the anther-lobe develops as the tapetum and its cells remain uninucleate throughout

behaving like the secretory type prior to meiosis in microspore mother-cells. Before reduction divisions, the tapetal cells lose contact with each other and migrate between groups of mother-cells which they begin to nourish. In their act of migration and wandering, these tapetal cells are somewhat similar to the amœboid tapetal cells but their identity with them is not altogether perfect because their cell-walls are intact. Such a behaviour of tapetal cells, as far as the author is aware, has not been recorded so far. Eventually, the tapetal cells disappear when meiotic divisions are complete.

Dept. of Botany,          V. R. DNYANSAGAR.
College of Science, Raipur, M.P.,
*January* 18, 1954.

## ALDRIN AND DIELDRIN FOR TERMITE CONTROL

EXPERIMENTS were conducted in a field known to be heavily termite infested, the two species being *Microtermes obesi* Holmgr. and *Odontotermes assmuthi* Holmgr., with various insecticides. The treatments were all applied to setts at planting when lying exposed in furrows immediately before covering them up with soil in the form of dusts, suspensions, or emulsions.

Speaking generally, every treatment was better than control and results were highly significant statistically. Germination was highest (44·4 per cent. and 45·8 per cent.) and incidence to setts was least (14·3 per cent. and 12·2 per cent.) in treatments with Aldrin and Dieldrin respectively compared to control where germination was only 19·1 per cent. and incidence to setts 79·3 per cent. The conventional treatments with B.H.C. chlorinated camphene or DDT were in the next range of efficiency, but considerably inferior to the former two. Incidence to the growing crop, throughout the year, was 2·1 per cent. and 4·7 per cent. in Aldrin and Dieldrin treatments respectively as against 48·1 to 75·2 per cent. in other treatments and control respectively. Even repeated applications of BHC to the crop did not materially reduce the incidence and in these cases the protection to the crop was limited to at best 3-3½ months after planting whereas in the case of Aldrin and Dieldrin treatments, the treatments gave complete protection right up to the end of the year till the crop was harvested. These were adequately reflected in yield of sugarcane per acre also

where Aldrin and Dieldrin were head and shoulders above the rest giving an extra yield of 121·9 and 116·0 md. per acre.

It has been found that these two insecticides can be applied even at later stages of the life of the crop, if termite infestation appears. Previously there was no help in such cases.

C. S. R. S., Pusa,      S. B. D. AGARWALA.
Bihar,      S. Z. H. NAQVI.
*January* 20, 1954.      R. P. SINGH.

## PHYSIOLOGY OF DIGESTION IN *LEPTOCORISA VARICORNIS* FABR. (HEMIPTERA: COREIDAE)

INVESTIGATIONS on the physiology of digestion in *Leptocorisa varicornis* Fabr., an important pest of paddy, were taken up in order to throw light on the physiological relationship between this insect and its host plants.

The digestive system of this insect consists of two sets of salivary glands, a short foregut, a long midgut and a very short pear-shaped hindgut. The midgut shows four distinct regions : a sac-like *first ventriculus,* a narrow tubular *second ventriculus,* a small dilated *third ventriculus* and a narrow tubular *fourth ventriculus* which is flanked with two rows of numerous minute cæca. The latter contain certain micro-organisms.

For the determination of enzymes in these organs, the usual practice of preparing the extracts by grinding the tissues was avoided in order to exclude the endoenzymes. The latter, in the living insect, are not liberated in the lumen of the gut and, hence, cannot take part in the digestion of food before it is absorbed. After clearing the alimentary canal of the insects by feeding them with distilled water for about 24 hours, they were fed on substrates corresponding to the enzymes to be tested. The contents of the lumen of different parts of the gut were then drawn out and incubated with appropriate substrates at 38° C. To this mixture were added a suitable buffer and a few drops of toluene. The action of the enzymes was detected by testing for the appearance of hydrolytic products and disappearance of the substrates by the methods recommended by Cole[1] and Feigl.[2] In all cases controls were carried out with extracts heated in boiling water for about 30 minutes.

The process of digestion was also checked up by feeding the insects on different substrates and then tracing their fate in the alimentary canal at different intervals after feeding.

The distribution of various enzymes in different parts of the digestive tract is indicated in **Table I**.

TABLE I

*Distribution of enzymes in the digestive tract of Leptocorisa varicornis*

| Organ | Amylase | Maltase | Invertase | β-gluco-sidase | Alkaline proteinase |
|---|---|---|---|---|---|
| Salivary glands | × | — | — | × | — |
| 1st ventriculus | — | — | × | — | × |
| 2nd ventriculus | — | — | × | — | × |
| 3rd ventriculus | × | × | — | × | — |
| 4th ventriculus | — | — | — | — | — |
| Hindgut | — | — | — | — | — |

× indicates the presence of the enzyme. Polypeptidase and lipase were not detected in any part of the digestive tract.

The ingested food, mixed with the salivary secretion, is collected in the first ventriculus where the proteins and part of the starch are hydrolysed by the alkaline proteinase and amylase respectively to yield polypeptides, dextrins and maltose. The enzyme invertase, though present in this region, digests sucrose when the food reaches the second ventriculus. β-Glucosidase, however, does not act upon β-glucoside, that may be present in the food, until the latter reaches the third ventriculus. In the latter region the digestion of starch and maltose is also completed by the action of amylase and maltase. The polypeptides do not seem to undergo further hydrolysis in the lumen of the gut. The products of digestion are conducted to the fourth ventriculus in regulated quantities and are finally absorbed. It may be noted that the above mentioned enzymes have not been detected in the fourth ventriculus and the hind-gut.

These results indicate that the morphological differentiation of the midgut in the Heteroptera is correlated with a corresponding physiological differentiation.

Dept. of Zoology,      K. N. SAXENA.
University of Delhi,
Delhi-8, *February* 1, 1954.

1. Cole, S. W., *Practical Physiological Chemistry,* 1944, Cambridge.
2. Feigl, F., *Qualitative Analysis by Spot Tests,* 1947, Elsevier, New York.

## TRIALS WITH PESTOX-3H, ON SUGARCANE SCALES

DURING 1953 a serious infestation of Scales (*Trionymus sacchari*) developed on Co. 513, Co. 313 and Bo. 11 varieties of sugarcane growing in 8′ × 8′ cages. This opportunity was utilised for experimental trials with 0·5 per cent. spray of Pestox. Observations on popu-

| Variety | Pre-treatment | 1st post-treatment | % reduction | Statistical merit | 2nd post-treatment | % reduction on pre-treatment | Statistical merit |
|---|---|---|---|---|---|---|---|
| | | | 1. Percentage of leaves affected* | | | | |
| Co. 513 | 4·01 | 0·98 | 75·56 | Highly significant | 0·60 | 85·58 | Highly significant |
| Co. 313 | 13·27 | 7·89 | 40·54 | do | 3·71 | 72·42 | do |
| Bo. 11 | 10·78 | 2·49 | 76·90 | do | 4·28 | 57·79 | do |
| | | | 2. Number of Scales per leaf* | | | | |
| Co. 513 | 27·67 | 0·43 | 98·08 | do | 0·78 | 96·99 | do |
| Co. 313 | 31·64 | 8·74 | 72·38 | do | 3·12 | 91·73 | do |
| Bo. 11 | 18·82 | 2·11 | 88·79 | do | 5·92 | 75·66 | do |
| | | | 3. Number of Scales per square inch of the affected leaf | | | | |
| Co. 513 | 91·90 | 0·93 | 97·78 | do | 1·84 | 95·46 | do |
| Co. 313 | 26·28 | 15·04 | 42·11 | do | 7·58 | 71·10 | do |
| Bo. 11 | 12·35 | 3·12 | 74·74 | do | 7·23 | 42·94 | do |

Figures transformed to sin/P.

lation was taken by nested sampling method (30 leaves per cage) immediately before and 8 and 38 days after treatment. Results presented in the table below show the high efficacy of the treatment, which was most so in Co. 513. In Co. 313 the translocation appeared to be slow but active life sustained better than in Bo. 11.

Entomology Section,   S. B. D. AGARWALA.
C.S.R.S., Pusa,   R. N. PRASAD.
*February* 2, 1954.

1. Agarwala, S. B. D. and Huque, M. W., *Ind. Jour Entomol.*, 1952. **14,** 3.

## BIOLOGICAL CONTROL OF THE BRINJAL MEALY BUG AND APHIS BY *HYPERASPIS MAINDRONI* SIC.

IN West Bengal *Phenacoccus isolitus* G. and *Aphis fabœ* are two serious pests on brinjal. They attack the plant almost simultaneously and quickly build up large colonies. The tremendous drain of plant sap caused by the feeding activity of these two pests produce characteristic white patches on the leaves. If the mealy bug infection becomes very high, the stems of the plant appear as if dusted with white powder.

A tiny predator beetle on brinjal mealy bug and aphis was recently collected along with their larvæ and eggs, and reared in the laboratory. They were identified as *Hyperaspis maindroni* Sic. of the family Coccinellidæ. This beetle had been so far recorded only from South India and this is the first record of the species from West Bengal.

In the field where DDT and BHC were used, a damaging infestation of a second generation of the pests was found to have developed. This infestation developed from eggs, larvæ and adults that were unaffected by insecticides. The consistency with which this infestation was associated with an application of the insecticides suggests that these materials interfere with the natural control by enemy insects of these pests. It is quite evident that biological control which at the beginning of the incidence of the pests is ineffective, becomes of considerable importance after some time.

NIRMAL CH. CHATTERJEE.
Ministry of Food & Agric.,
Govt. of India, Calcutta-40,
*March* 10, 1954.

## PROTEINS IN HEALTH, DISEASE AND INDUSTRY

A SYMPOSIUM on Proteins in Healht, Disease and Industry is to be held under the auspices of the National Institute of Sciences of India, during October 8-9, 1954, at New Delhi. Among the subjects for discussion are: Food proteins, their amino acid composition and nutritive value; Functions of proteins in the body including their relationship with vitamins, hormones, enzymes, etc.; Protein and amino acid preparations in food and in therapy; Biosynthesis of amino acids and proteins; Synthesis of amino acids and polypeptides; Structure and molecular weight of proteins; Methods of analysis of proteins and amino acids; Bacterial products from proteins and their uses in therapy; Preservation of proteins and protein foods; Industrial application of proteins. Those intending to participate in the symposium are requested to send in their abstracts before 30th June 1954 to Dr. U. P. Basu, Convener, Bengal Immunity Research Institute, 39, Lower Circular Road, Calcutta-16.

# REVIEWS

**Mathematical Aspects of the Quantum Theory of Fields.** By K. O. Friedrichs. (Interscience Publishers, Inc.), 1953. Pp. viii + 272. Price $5.00.

Despite many fundamental difficulties in quantum field theory, a close agreement has been obtained between theory and experiment for quantum electrodynamics. This would seem to indicate the need for a close inspection of the mathematical foundations of the subject; this close inspection would, it is hoped, show more clearly the cause of the difficulties.

The inspection is given in a precise manner by Friedrichs, who considers the basic notions of field theory for non-interacting boson and fermion fields and also simple interaction problems. The notation used is that of general operator theory and not of quantum field theory; this is only to be expected in a mathematical approach to the subject through operator and Hilbert space considerations.

At the beginning of the book, the symbolic nature of operators with commutation relations containing the δ-function is noted. That these symbolic operators can be given a precise definition in terms of other operators is shown later, these latter operators depending on elements of a general Hilbert space and not on points of a Euclidean space. However, these well-defined operators are not explicitly used for the development of the theory, and a loss of internal consistency of the development results. This loss would appear to be compensated for by keeping the development closer to the intuitive mathematical approach of the quantum field theorist, and thus allowing him greater ease in reading the book.

The mathematical definition of biquantized operators and the Hilbert space on which they act is fully developed from single particle operators and states, and gives rise to the Fock space representation.

This representation is then applied to a boson field in interaction with a given source distribution. An exact solution of this system is obtained, and an interesting analysis of the infra-red catastrophe is given. A similar analysis is given of a field modified by a linear homogeneous force, and transition probabilities are again determined.

Since a mathematically satisfactory treatment of non-linear interactions between quantised fields canont be given, these interactions are not considered. Fredrichs even suggests that fundamentally different laws of non-linear interaction should be adopted, so as to admit of mathematical treatment; this, however, is not considered in the book.

The treatment throughout is in a non-relativistic form, and it would seem a pity that no attempt has been made to incorporate explicit relativistic invariance into the foundations of the theory. J. G. TAYLOR.

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**Tables of $10^x$,** NBS Applied Mathematics Series 27. (Order from Government Printing Office, Washington 25, D.C.). Pp. 543. Price $3.50.

Although there are a number of handy tables of logarithms to 10 or more places, these tables necessitate the use of inverse interpolation for finding the antilogarithm. Thus, a table of antilogarithms is needed. The present volume gives antilogarithms to the base 10, or $10^x$ in the form of two tables, a readily interpolable table for 10-decimal accuracy and a basic radix table for 15-figure accuracy. When used in conjunction with logarithmic tables in any extensive computations involving logarithms and antilogarithms, the *Tables of $10^x$* will save considerably more labour than will logarithmic tables used alone. The ease of performing linear interpolation by machine eliminates the need here for differences and proportional parts. The fine interval of $10^{-5}$ in the argument permits determination of the full 10-decimal places by linear interpolation alone with a small 10th place correction that can be done mentally.

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**Low Frequency Amplification.** By N. A. J. Voorhoeve. (Philips Technical Library), 1953. Pp. xv + 495. Price Rs. 24-4-0.

The volume under review represents one of the latest additions to the very popular Philips Technical Library Series and is, according to the authors, 'a treatise on the technical and scientific principles and the modern practical use of LF amplification'. Though acoustics, in the last few decades, has been revolutionized by the rapidly developing electronic measuring methods, there has been no corresponding attempt by text-book writers to present an integrated account of audio problems. The pre-

sent volume fills that need adequately and hence will be of immense benefit to the amateur audio enthusiast and the practising acoustical engineer.

More than half the book is concerned with electronic principles, but emphasis is laid on those topics relating to audio work. Valuable design by data on Class B amplifiers, pre-amplifiers, output power tubes, feed-back circuits, and matching networks has been included in this portion. The acoustics problems dealt with are mostly applied in nature with emphasis on microphones, loudspeakers, PA systems, and recording devices—disc, tape and film. Throughout the book, there are extensive references to, and data on, Philips products, as is characteristic of other volumes in this series.

Finally, there are two general comments, this reviewer has to offer : (*i*) the utility of the book is considerably enhanced by an extensive bibliography appended to every chapter, and (*ii*) the price of the book is very reasonable in these days when the purchase of a technical book is, for most of us, almost an investment.

It is hoped that such a book as this will find wide acceptance as a standard text-book in our engineering colleges where acoustics and audio figure in the curriculum.    RAM K. VEPA.

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Data and Circuits of Television Receiving Valves. (*Book III c of the Series of Electronic Valves.*) By J. Jager. (Philips Technical Library, Eindhoven), 1953. Pp. 216.

Television receivers presented completely new problems to the tube designer and the present data book reflects the result of a decade and a half of intensive research and experimental development.

The front end of a TV-receiver, operating in the vhf or uhf range requires tubes with reduced transit-time limitations and very small equivalent noise resistance. In addition, they have to meet the general wide-band requirement of high transconductance combined with low tube capacitances : EF 80 and ECC 81 are designated to this part of a television receiver. Both are also used for signal conversion, whereas EF 80 (pentode) is exclusively employed in the i.f. parts. The double diode EB 91 has separate cathodes and thus can be used simultaneously as video detector and DC restorer. The PL 83 is the typical video output tube feeding one of the picture tubes listed in this data book (MW 36-44, MW 36-24, MW 43-43). Even for the sound part we find special tubes, like PL 82, ECL 80, EQ 80. The difficult prob-

lem of horizontal output amplifier can be solved by using the new PL 81 in combination with PY 80 and PY 81 booster tubes. The rectifier tube EY 51 is able to handle the high peak inverse voltage of 17 KV in a fly-back EHT system.

The last third of the book brings many circuit descriptions with full explanations. Briefly, a highly useful reference book for any TV designer.

                    R. FILIPOWSKY.

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Radio Engineering, Vol. I. Second Edition. By E. K. Sandeman. (Chapman & Hall), 1953. Pp. 779.   Price 60 *sh*.

The book first appeared in 1947 and since then it has become a very familiar text-book. There are many good reasons for its increasing popularity : the fact that two volumes of nearly 1,400 pages are exclusively devoted to radio broadcasting proves that we may be sure to find in these volumes a good deal of special information which has to be omitted in more general text-books. The author's close connection with the engineering field in · one of the world's largest broadcasting corporations (BBC) can be felt when reading any of the 16 chapters of the first volume. Many operational features of particular circuits or sets are disclosed, and frequently we learn interesting facts from otherwise unpublished technical reports resting in the files of this Corporation. Last but not least, we have to congratulate the author for his efficient selection of the topics to be discussed more elaborately. Thus he has restricted the presentation of valve fundamentals to only 30 pages while extending on the other side the chapter on · modulators to over 110 pages and the paragraph on feeders, aerials and coupling devices to 130 pages.

Unfortunately, we cannot expect such a comprehensive work to be absolutely perfect at its birth. Reviewers of the first edition disclosed many shortcomings and errors and the friends and admirers of the author hoped that a second edition would be highly improved in this respect. The preface to the second edition stresses again the close link-up of the book's content with BBC practice. This fact has been much criticised by reviewers of the first edition (see for example, *Wireless Engineer*, February 1948, page 62) and, indeed, it was generally expected that a second edition would be on a broader basis including well established high power transmitter practice outside the realm of the BBC. The preface then continues to assure the reader that "with this very able

help and a certain amount of diligence on the part of the author, the book has been very thoroughly revised".

The reader has no reason to belittle this statement. The very fact, however, that still quite a few small errors are prevailing (take as an example page 32, where the dimensions of $\rho$, the specific resistance, is given in ohm/cm.$^3$, instead of ohm × cm.) indicates that only by co-operation of a large number of specialists, communicating any discovered deficiency to the author, the book may finally become *the* standard text-book on transmitter technique. To reach this aim it will be unavoidable for the author to introduce the MKS system of units, as has been suggested by several reviewers of the first edition.

Apart from a new section on transmission line filters and a treatment of noise factor calculation in receivers there is no major change from the first edition. Approximately one-third of the book is devoted to fundamentals of AC circuits and resonance. A very useful essay on harmonic analysis and distortion precedes the tube fundamentals and the amplifier chapter. Oscillators and drive equipment lead the second half of the book, which contains an excellent survey of transmitter types (BBC) and their operation and maintenance, besides the previously mentioned large chapters on modulators, aerials and feeder lines.

R. Filipowsky.

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**Condensed Pyridazine and Pyrazine Rings (Cinnolines, Phthalazines and Quinoxalines).** By J. C. E. Simpson. (Interscience Publishers, Inc.), 1953. Pp. xvi + 394. Price $ 12.50. (Subscribers to the series, $ 11.25.)

The author of this monograph, the fifth volume in Dr. Weissberger's series on the chemistry of heterocyclic compounds, died in February 1952, and the later work connected with the production of the book was carried out by Dr. C. M. Atkinson, a colleague of Dr. Simpson on the scientific staff of the Medical Research Council in England. The book is regarded as a continuation and extension of Mayer-Jacobsen's *Lehrbuch der Organischen Chemie*, Vol. II, 3, and the literature coverage therefore commences mainly from 1917. The preface is dated September 1950, and the references include 1949 literature. Part I deals with cinnolines, to the chemistry of which Dr. Simpson himself has made a substantial contribution. Throughout the book a general account of the synthesis and properties of a given type is followed by a table of the physical proper-

ties of a series of compounds and references to the original literature. The treatment includes cinnolines containing additional fused rings, both homocyclic and heterocyclic, condensed phthalazines and azaphthalazines, quinoxalines condensed with homocyclic rings and with nitrogenous heterocyclic rings, and azaquinoxalines. Ultraviolet absorption spectra of cinnoline and quinoxaline derivatives, basic strengths of cinnoline, phthalazine and quinoxaline derivatives (stated as $p\mathrm{K}a$), and antibacterial and parasiticidal activities of cinnoline and quinoxaline derivatives are given in three Appendices.

2 : 3-Dihydroxyquinolines react with *o*-aminophenol to form oxazine derivatives and with *o*-phenylenediamine to form quinoxaloquinoxalines; these are mentioned, but not the reaction with monamines. The 2 : 3-dihydroxyquinoline derivative obtained by the condensation of 1 : 2-diaminoanthraquinone with oxalic acid condenses with amines such as *m*-toluidine to form vat dyes (*e.g.*, Indanthrene Brilliant Scarlet RK).

The present volume is as comprehensive and scholarly as others in the series which are a necessary addition to a chemical library.

K. V.

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**Inorganic Syntheses, Vol. IV.** *Editor-in-Chief:* John C. Bailar, Jr. (McGraw-Hill Book Company, Inc.), 1953. Pp. xii + 218. Price $ 5.00.

This volume which is the fourth in the series is divided into 8 chapters, the arrangement being based on Mendelejev's periodic classification including the A and B sub-groups. It deals with the method of preparation of some 58 compounds, which although of importance in general research, are either not readily available or should preferably be prepared by the research worker for immediate use.

The method recommended for the synthesis has in each case been confirmed independently in different laboratories. Each synthesis is prefaced by a short account of the principles involved and the methods available. The procedure is then set out in detail indicating the exact quantities of reactants to be employed as well as the necessary experimental conditions. The apparatus to be employed is described with all essential details and often illustrated by clear sketches. It is noteworthy that only the simplest possible set-up and common manipulative technique, such as, rudimentary glass-blowing are suggested in each case, without sacrifice of efficiency or yield of the products. The successive steps in the synthesis

re fully described with due emphasis on the recautions called for. Experimental data concerning the yields and the purity of the product obtained as well as of the associated impurities are furnished in each case along with its important physical and chemical characteristics.

This publication is a most helpful reference book for preparative inorganic chemistry. The information given is so precise and complete as to enable any chemist to adopt with confidence the synthetic procedures suggested.

The printing and get-up of the book is excellent, and it is singularly free from any misprint or error in the text or flaws in the diagrams. It can be heartily recommended as a thoroughly reliable book of reference for all chemists alike. **K. R. K.**

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**Soap Manufacture,** Vol. I. By A. Davidsohn, E. J. Better and J. Davidsohn. (Interscience Publishers, Inc.), 1953. Pp. xii + 525. Price $ 12.50.

Interscience Publishers, Inc., have been publishing a series of very valuable monographs on ats and Oils' and the present volume is a very welcome addition to the series. The book contains information on the theoretical principles of soap-making, raw materials of soap manufacture, practical aspects of soap-boiling processes and special soap products. Each of these major divisions is admirably treated.

The study of the principles of saponification of very great importance to the manufacturer as well as to the colloid chemist. The treatment of this subject in Part A is masterly. A young student of the subject has often to puzzle about the various raw materials has to work with. He has only to read through Part B to find all the information he wants. The practical aspects of soap-boiling processes and special soap products are elegantly treated in Parts C and D.

The reviewer had, for some years, the responsibility of instructing young graduates in the chemistry of soap manufacture in close collaboration with a leading firm. One of the difficulties he then experienced was to recommend a good readable book on the subject. That difficulty may be said to have been completely overcome by the present volume. It is not only rich in correct and precise information, but is handy, free from all avoidable mistakes and sustains the readers' interest to study with profit.

This book can be heartily recommended not only to the manufacturing chemist and the technician but also to all who have interest in colloid and other branches of physical chemistry. It should find a place in every scientific or technical library. **K. N. M.**

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**Practical Chromatography.** By R. C. Brimley and F. C. Barrett. (Chapman & Hall, Ltd.), 1953. Pp. 128. Price 15 *sh.* net.

This laboratory manual gives in a nutshell, and without sacrificing clarity, a good account of the practical details of various procedures usually employed in chromatographic analysis. In addition to paper chromatography, column chromatography based on adsorption, partition and ion-exchange mechanisms receives a scholarly and authoritative treatment. The last chapter is devoted to the description of various designs of fraction-collectors. As is to be expected in a book of this kind, theoretical considerations are relegated to the background. The descriptions given are clear and concise and are accompanied by illustrations wherever necessary. Emphasis is placed on the actual *modus operandi* rather than on the application of the methods. The book is a useful practical guide for chromatographic analysis, but unmistakably colored by the progressive research interests and activities of the authors, who have made important contributions to the development of chromatographic techniques. The book is remarkably free from typographical errors and can be recommended to all research workers who are either already using or contemplating to use the elegant techniques of chromatography in their investigations. **K. V. Giri.**

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**Annual Report for 1952-53 of the Nutrition Research Laboratories.** (Coonoor, South India). Pp. 40.

The report deals with the activities of the Nutrition Research Laboratories of the Indian Council of Medical Research for the year 1952-53 and gives in the main an account of the biochemical, clinical, pathological and field investigations carried out during the year. Vitamins and proteins have been studied on the biochemical side while in clinical nutrition, extensive studies have been carried out on different aspects of nutritional œdema, and several important results reported. Field work such as nutrition survey and determination of hæmoglobin levels in children have also been

carried out. The report is interesting to read and the 17 publications listed in the end give an idea of the significant contributions made by this institution in the field of nutrition research. P. S. SARMA.

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**The Birds of Burma.** By Bertram E. Smythies. Thirty-one colour plates by Commander A. M. Hughes. (Published by M/s. Oliver & Boyd, Edinburgh), 1953. Pp. 668. Price £ 4-4-0.

The first edition of 1,000 copies of this book printed in Rangoon in 1940 was sold out rapidly with very few copies selling outside Burma. In the Japanese invasion, the books available in Burma were seized and shipped to Tokyo where they were later destroyed in an air raid. During the war, an American ornithological paper listed the number of copies in existence and (speaking from memory) only 12 or 14 were traceable, the three copies in Bombay being overlooked.

The second edition is welcome as it fills an urgent need in an extremely interesting ornithological area. Few countries have this wealth and variety of bird life in so small an area. The Indo-Malayan element is prominent but the numerous hill ranges form interesting lines of division between different races. The preface to the second edition contains the interesting story of the first edition while the introduction deals with the history of ornithology in Burma and goes into some detail regarding the zoological affinities of the area. The author appears to have succeeded in bringing under one cover all available information regarding the birds of Burma and it will therefore be an indispensable reference for any work on the birds of that area.

The book is excellently got up and the 31 coloured plates each illustrating 8-10 birds which were included in the first edition are reproduced. It is unfortunate that the colours in many cases have not blended well and the black and greys in crows, bulbuls, treepies, jays and several other birds have in many places become blue and green.

The author laments that a chapter in Burma's ornithological as well as political history closed in 1948 and draws attention to the fact that he is unable to find any contribution by a Burman national in the bibliography to his work, but it is hoped that this excellent handbook, though highly priced for the beginner, will be used by many young enthusiasts in that country. HUMAYUN ABDULALI.

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**Books Received**

*Spot Tests—Inorganic Applications,* Vol. I. By Feigl. (Elsevier Publishing Co.), 1954. Pp. xii + 518. Price 45 *sh.*

*Elsevier's Encyclopædia of Organic Chemistry.* Vol. I2-B, Series III. Edited by F. Radt. (Elsevier Publishing Co.), 1953. Pp. xiii + 3965-4560. Price £ 21.

*Chemistry of Carbon Compounds,* Vol. II, Part B. By E. H. Rodd. (Elsevier Publishing Co.), 1953. Pp. xiv + 489-1,092. Price £ 5-5-0.

*Servo Mechanisms.* By John C. West. (English University Press). (Orient Longmans, Madras-2), 1953. Pp. 238. Price 25 *sh.*

*Australian and New Zealand Botany.* By J. McLuckie and H. S. McKee. (Associated General Publications Ptg., Ltd., 166, Phillip Street, Sydney, Australia), 1954. Pp. xx + 758. Price £ 4-4-0.

*Fluorescence Analysis in Ultra-Violet Light,* Fourth Edition. By Julius Grant. (Chapman & Hall), 1954. Pp. xvi + 560. Pirce 52 *sh.* 6 *d.*

*Fruit from Trained Trees.* By Stanley B. Whitehead. (McMillan & Co.), 1954. Pp. viii + 151. Price 10 *sh.* 6 *d.*

*Yeast Technology.* By John White. (Chapman & Hall), 1954. Pp. xvi + 431. Price 55 *sh.*

*The Mechanism of Enzyme Action.* Edited by W. D. McElroy Bentley Glass. (The Johns Hopkins Press, Baltimore 18 Maryland), 1954. Pp. xvi + 819. Price $ 11.00.

*Tables of Circular and Hyperbolic Sines and Cosines for Radian Arguments.* (NBS Applied Maths. Series 36). (U.S. Govt. Printing Press, Washington 25 D.C.), 1953. Pp. x + 406. Price $ 3.00.

*Detergency Evaluation and Testing* (Interscience Manual 4). By J. C. Harris (Interscience Publishers, Inc.), 1954. Pp. x + 210. Price $ 3.75.

# SCIENCE NOTES AND NEWS

## Occurrence of Kodurite in Patna State, Orissa

Shri P. C. Pande, University Department of Geology, Nagpur, writes as follows :—

In the specimens collected by the author, the kodurites are exposed only in some manganese quarries which consist of manganese garnet (spandite), manganese pyroxenes, felspar and quartz. The associated felspars are kaolinised and have given rise to large masses of kaolin. The unaltered portions consist of orthoclase and microcline.

The garnets are pinkish red, friable and in shining grains, occasionally associated with apatite of bluish green colour. The manganese pyroxenes are dark green and in some specimens, the prismatic cleavage is well developed. At some places pseudomorphs of manganese ore after pyroxenes are also found. Quartz is abundant as irregular grains.

## Ravenelia on Abrus precatorius Linn.

Dr. B. Padhi, Department of Botany, Ravenshaw College, Cuttack, writes as follows :—

Leaves of Abrus precatorius Linn. were found very heavily infected in the winter months of 1952-53 and 1953-54, in the Botanical Gardens of the Ravenshaw College, Cuttack. In one case almost all the leaflets were affected. The fungal pathogen has been identified as Ravenelia ornata Syd., which has been reported on leaves of A. pulchellus Wall. in Northern India (Butler and Bisby, The Fungi of India, 1931, p. 77). The rust on A. precatorius differs from the original description (Saccardo, Syllago Fungorum XXI, 1912, p. 738) of R. ornata in measurements of teleutosporic structures, but the author does not think that such differences are significant enough to warrant the creation of a new species. The rust collected on A. pulchellus growing in the same locality also shows similar magnitudes of variation.

## Physicians' Report on Tetracycline

A report on the first extensive clinical trials with the new broad-range antibiotic tetracycline shows it to be effective against several diseases, and well tolerated by patients. The drug was named 'tetracyn' by scientists of Chas. Pfizer & Co., Inc., who discovered it as a result of their identification of the chemical structure of terramycin,

On the basis of their experience with 179 tetracycline-treated patients, the majority of whom suffered from infections of the respiratory and urinary tracts, Dr. Maxwell, Finland, and group of Boston physicians conclude in a recent issue of the Journal of the American Medical Association that the antibacterial activity of tetracycline closely resembles, and in most respects is almost identical with that of oxytetracycline (terramycin) and chlorotetracycline (aureomycin).

## Dermatitis due to Penicillin

The urticaria which has been occurring among nurses and midwives is the result of sensitisation of the skin produced by contact with the antibiotic solution. Streptomycin appears to be the worse offender. The method suggested by the Ministry of Health, U.K., designed to minimise the risk of this kind of dermatitis, is to expel the air from the hypodermic syringe used for injecting the antibiotic while the needle is still in the bottle. The time-honoured technique in which the syringe is charged, removed from the bottle and inverted before expelling the air thereby stands condemned.

## Fellowships for Atomic Research

The Indian Atomic Energy Commission has decided to award 10 Junior Research Fellowships of the value of Rs. 250 per month each and six Senior Research Fellowships of the value of Rs. 400 per month each for study and research in cosmic rays and nuclear physics. These Fellowships will be tenable for two years, which may be extended as a special case by the Atomic Energy Commission for a further period not exceeding one year.

Applications on the prescribed form, obtainable from the Atomic Energy Commission, Old Yacht Club, Apollo Pier Road, Bombay-1, should be submitted through the University or institution concerned so as to reach that office not later than May 15, 1954.

## University of Madras Prizes

The Maharaja of Travancore-Curzon Prizes for 1954-55.—Two prizes, one in each of the following groups of subjects, will be awarded by the Syndicate for the best essay or thesis written by any graduate of the Madras Uni-

versity in the subject on any topic dealing with one of the subjects mentioned in the following two groups: (*i*) Chemistry, Bio-Chemistry and Agricultural Chemistry; (*ii*) Pharmacology, Pathology and Bacteriology. The value of each prize is Rs. 250. Competitors should submit their theses so as to be received by the Registrar not later than the 1st March 1955.

*Sir William Wedderburn Prize*, 1955.—The prize which will consist of books of the value of Rs. 45, will be awarded to the student, who having qualified in chemistry for the B.Sc. (Honours) or M.Sc. not more than two years previously, has shown aptitude for research. Competitors should submit their theses so as to be received by the Registrar not later than the 30th April 1955.

Further particulars may be had from the Registrar, University of Madras, Madas-5.

### *Endeavour* Prizes

The Imperial Chemical Industries, Ltd., Publishers of the scientific review, *Endeavour*, have offered the sum of 100 guineas to be awarded as prizes for essays submitted on the following subjects: The Upper Atmosphere; Heat of the Earth; Coal as a Raw Material; Water-Supply; The Span of Life and Colour Photography. The competition is restricted to those who are under 25 years of age on 1st June 1954.

The essay, which must be in English and typewritten should not exceed 4,000 words in length and only one entry is permitted from each competitor. In judging the results, special attention will be paid to the originality of approach to the subject, and great importance will be attached to literary style.

Entries should reach the Assistant Secretary, British Association for the Advancement of Science, Burlington House, Piccadilly, London, W.1, before 1st June 1954.

### Burmah-Shell Scholarships for 1954

Burmah-Shell have advertised for the third year in succession two Loughborough College Scholarships for 1954 to be awarded annually for a period of four years to Indian students who intend to adopt Mechanical Engineering as their profession. The scholarships will normally be tenable from the commencement of each college session, *i.e.*, September at Loughborough College, Leicestershire, England. The closing date for the applications is 1st June 1954. The appropriate application forms can be had from: The Secretary of the Committee of Selection, Burmah-Shell Scholarships (Loughborough College of Technology), C/o. Burmah-Shell Oil Storage & Distributing Co. of India, Ltd., P.O. Box No. 688, Bombay.

### Royal Institute of Chemistry—N. India Section

At the Annual General Elections of the North India Section of the Royal Institute of Chemistry held at Delhi on 13th March 1954, the following office-bearers were elected for the year 1954-55: *Chairman*: Dr. B. Viswa Nath; *Hony. Secretary and Treasurer*: Dr. G. S. Saharia; *Hony. Auditor*: Mr. B. N. Sastri.

### Dr. K. R. Nair

The D.Sc. Degree of the London University has been conferred on Dr. K. R. Nair, Statistician, Forest Research Institute, Dehra Dun. Dr. Nair is also a Fellow of the American Statistical Association and has made extensive contributions relating to Fisherian Theory of Experimental Designs, in the field of Statistics.

### Award of Research Degree

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri Keshav Gangadhar Marathe for his thesis entitled "Syntheses of Karanjin Analogues by the Ranjorwar Reaction, etc.".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri Gangadhar Vyankatesh Bhide for his thesis entitled "A New Method for the Synthesis of 2-Acyl-3-hydroxy-coumarones, etc.".

### CORRECTION

Vol. 23, No. 2, p. 52: Note on "Study of the Action of Acid on Chromate Ion by Glass Electrode": In Table I, Column 4, please *read* $K_2 \times 10^{-2}$ *for* $K_2 \times 10^2$.

Vol. 23, No. 2, p. 42: Article on "The Occurrence of $C_8$-Unit in Natural Products": In Structural Formula VII, *read* $OCH_3$ *for* OH.

## UTILISATION OF SOLAR ENERGY

AT the present rate of fuel consumption it has been estimated that the world's supply of readily available fuels such as coal, oil and gas will be exhausted in less than 100 years. Nuclear fuels too, are likely to last only for about another two centuries. As a long-range problem, therefore, researches on methods of utilizing solar energy are of vital importance, particularly in countries like India, which are fortunately situated in regard to the supply of solar radiation. In this connection, the deliberations of a recent symposium* on the utilization of solar energy, sponsored by the National Science Foundation and the University of Wisconsin, U.S.A., will be read with much interest.

The first general discussion at the symposium centered round the storage and utilisation of solar energy for house heating, water heating and cooking. The discussion indicated that knowledge of absorbents of solar energy was well advanced, but that considerable improvement was still necessary before solar house heating could be achieved without the use of auxiliary fossil fuels. One of the major problems in this connection is the storage of energy through the night, and during long periods of overcast or stormy weather. Probably, improvements in house design would make possible better use of the sun's heat in both summer and winter.

Regarding the generation of solar power, it was felt that small power units could be got up in certain parts of the world, though at from 2-3 times the current cost of power production

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* Held at the University of Wisconsin in September 1953, reported in *Science*, 1954, **119**, 82.

from coal and oil. The chief disadvantage here is that the power would be intermittent because it can be produced only during the hours of sunlight.

Closely allied to the power problem is the solar evaporation of sea-water. Some progress in this regard has been made by dissolving dyes in salt water in order to improve the absorption of energy. One part per million of dye may increase absorption by as much as 30 per cent. in the evaporation of water to yield salt.

But it is obvious that for any widespread use of solar energy, there must be a better understanding of the meteorological implications. If improved methods for protecting crops against frost could be devised, and the growing season thus lengthened, the food supply in certain areas of the world could be increased appreciably. Conversely, if absorption could be induced on snow surfaces so that melting would be speeded up the ground would be made available for planting sooner in the spring. Meteorology could thus make an important contribution to the advancement of solar energy by developing an improved method for specifying the amount of solar radiation at any given point on the globe.

The Conference gave special attention to those areas that show the greatest promise of making major contributions to the utilization of solar energy as a source of power and felt that chemists should be urged to search for a suitable solar compound which will absorb sunlight through photochemical reactions, store up the energy and then release it in a way suitable for practical use. To discover such a compound presents a real challenge, but basic research on the question should be encouraged; for the use of sunlight in photochemical reactions offers many theoretical advantages over its use as heat in engines. However, one of the difficulties likely to be met with is that the products of such photochemical reactions may immediately react, and reverse the reaction.

An example of a possibly useful photochemical reaction is the production of hydrogen and oxygen from water, using cerium salts as the absorbent to transfer the energy needed to make the water dissociate. The hydrogen and oxygen could be stored and later recombined to give back the stored energy. Another possibility is the absorption of energy by one side of a photovoltaic cell or an electrical battery, while the second side of the cell is kept in darkness. The side absorbing the energy from the sun would transmit the energy through an electric circuit to the side which is kept in darkness.

In addition to studies of the kind mentioned above, considerably more work should be done on the thermo-element method, in which two different electric conductors are connected, with one junction heated by the sun and the other junction kept cold. The resulting current could be made to do work ; however, it will be necessary to find metals or alloys which, when connected together in this way, will produce substantially higher voltages than any produced so far.

Nature's own method of utilizing solar energy in growing plants through photosynthesis is a remarkable phenomenon which can also guide us in our approach to the collection of solar energy. We are just beginning to understand photosynthesis, but perhaps eventually the same series of reactions may be produced artificially without any requirement of the growing plant or good soil conditions.

Considerable attention was devoted at the symposium to the possibilities of a 'poor man's solar engine'. Although such engines would be inefficient thermodynamically and economically in comparison with modern engines, it was felt that they might find extensive use, particularly in countries which are not industrialised. The night interruption of power would not be a disadvantage in operations such as the pumping of water for irrigation.

No great achievements of practical value were reported in this attack on the problem of utilizing solar energy, and it was generally agreed that no new era of direct utilisation of solar energy is yet in sight. However, many of the participants of the Conference, including architects, engineers, chemists and meteorologists, were pleased to find that substantial progress is being made in the preliminary development of solar house heating, solar power production, evaporation of sea-water, and in the application of meteorology. They were also interested to discover that there are many areas of physical chemistry, physics and engineering where fundamental research may well lead to significant advances in this direction.

# SPECTROSCOPIC MEASUREMENT OF THE DIURNAL VARIATION
## OF THE EFFECTIVE OZONOSPHERE TEMPERATURE

### A. U. MOMIN

*Radiation Laboratory, Meteorological Office, Poona-5, India*

THERE appears to be so far no experimental determination of the diurnal variation of the temperature of the ozonosphere. As a considerable amount of solar energy is absorbed by this layer in the ultra-violet region of the spectrum it should be expected to undergo a diurnal variation in temperature.

This problem has been theoretically examined by a few workers, but their results vary considerably, as accurate data on the vertical distribution of ozone and the spectral energy distribution of the sun in the ultra-violet region were not available to them. For example, Penndorf[1] has calculated the diurnal range of ozonosphere temperature as 0·3° C., while Gowan[2] gives a value of 30° C., and London[3] 4·5° C. for the 45-50 km. region. Recently, however, Johnson[4] utilising the direct measurements of the above quantities made with V-2 and Aerobee rockets at White Sands Proving Grounds, New Mexico, has calculated the range to be of the order of 5-6° C. for a height of 48 km.

The experimental determination of ozonosphere temperatures made with rockets are yet too few to enable one to estimate the diurnal variation of the temperature of the ozonosphere. A. Adel[5] has made spectroscopic measurements of ozonosphere temperatures using the 9·6 μ ozone band, but as his measurements require the presence of either the sun or the moon, it is not always possible to make a complete series of readings to get an idea of the diurnal variation. The present writer has developed a method similar to Adel's, by which measurements can be made both day and night so long as a clear patch of sky near the horizon is available.

The method essentially consists in comparing the emission of the thermocouple detector in an infra-red spectroscope at 9·6 μ, with the emission of the atmospheric ozone layer at the same wavelength, which is the centre of the strong rotation-vibration band $\nu_2$ of ozone. Since the temperature of the detector in the spectroscope is kept constant and is known, the temperature of the ozone layer can be obtained from a simple graphical solution using a series of Planck's curves.

The spectroscope, which is a Beckman model IR-2 with KBr-prism, modified for use with external radiation sources (Momin[6]) is

directed through front-aluminised reflectors to the clear sky as close to the horizon as possible, and the wavelength is set in the 9 μ region in which the atmosphere is almost completely transparent. On account of this transparency of the atmosphere the thermocouple is radiating out to space, which may be taken to be at the absolute zero, and thus undergoing cooling at a rate determined by its temperature according to Planck's Law. This cooling appears as a negative e.m.f. in the thermocouple circuit which can be measured by reversing the phase of the mechanical synchronous rectifier of the IR-2 Spectroscope, in relation to its beam modulation. Now the wavelength range between 9 μ and 10·5 μ is scanned with readings being taken at intervals of 0·1 μ. A plot of these deflections against wavelength gives a curve which is the envelope of the Planck curve for the radiating thermocouple, superimposed on which is the emission band of the atmospheric ozone with its centre at 9·6 μ. Since the emission of ozone is in the opposite direction, it appears as a decrease in the emission of the thermocouple as shown in Fig. 1. The relative value of
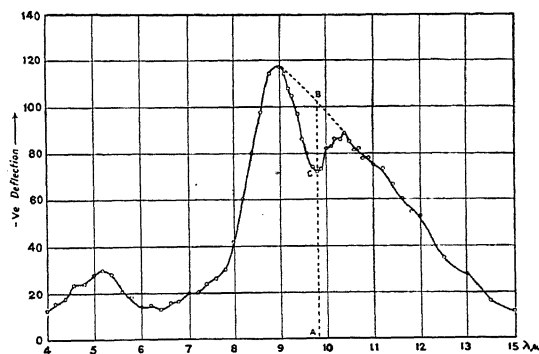


FIG. 1.

Jλ — 9·6 μ for the thermocouple is given by AB and the Jλ — 9·6 μ for ozone layer by BC. Since we know the temperature of the thermocouple, which is kept constant by means of a thermostat, the corresponding equivalent black body temperature of the ozone layer for giving emission equal to BC can be obtained from black body emission curves based on Planck's Law. One measurement of the ozone temperature takes only a few minutes.

The thermocouple being at constant temperature, a fixed value for AB is assumed and thus the effect of any background radiation due to water vapour or dust is eliminated in the estimation of the diurnal variation of ozonosphere temperature.

The two main assumptions in this method are:

(i) that the ozone layer is emitting like a black body;

(ii) that any diurnal variation in the quantity of ozone does not affect the readings.

Since we are using a portion of the sky about 10° above the horizon, the ozone mass involved is approximately 5 times that in a vertical direction and with the normal amount of ozone at Poona which is about 0·16 to 0·18 cm. (at N.T.P.), we should obtain absorption almost approaching saturation at the centre of the band. This is verified experimentally by the fact that very close to the horizon our records show absorptions of the order of 92 to 95 per cent. This means that in assuming the ozone layer as a complete absorber at the centre of the band, we are underestimating its emission by only a small percentage; but, for determining the diurnal range of temperature, which is our main purpose, the error involved is negligible. The fluctuations in the amount of ozone also have very little effect on the ozone emission as the absorption at the centre of the band is almost fully saturated.

Using this method, measurements have been made on some clear days at Poona (Lat. 18° 30′ N, Long. 73° 51′ E, Alt. 1,800′ above sea-level) during May, October and November 1953. Fig. 2 gives a typical curve for November, from which we can see that the range of the equivalent black body temperature comes out

as about 15° C. The readings for May and October also give a range of the same order although in May the ozonosphere temperature appears to be slightly higher, thus indicating the possibility of a seasonal variation. It must



DIURNAL VARIATION OF OZONOSPHERE TEMPERATURE.
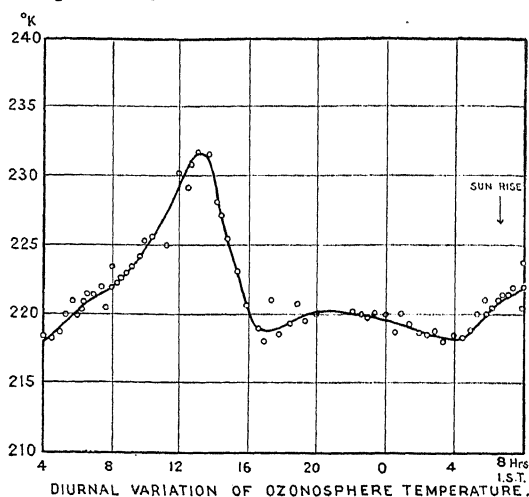
FIG. 2.

be pointed out, however, that the above results are preliminary and we need a much longer series of data for more definite conclusions.

The writer wishes to express his best thanks to Dr. L. A. Ramdas, for his kind interest and encouragement and valuable discussions, and to the C.S.I.R. for financing the research scheme.

1. Penndorf, R., *Beiträge zum Ozonproblem, Veröff. Geophys. Inst. Leipzig*, 2nd Series, 1936, **8**, 181.
2. Gowan, E. H., *Proc. Roy. Soc.*, 1947, **190A**, 219 ; 1947, **190**, 227.
3. London, J., *Bull. Amer. Met. Soc.*, 1951, **32**, 399.
4. Johnson, F. S., *Ibid.*, 1953, **34**, 3, 106.
5. Adel, A., *Astrophys. J.*, **105**, 406.
6. Momin, A. U., *Jour. Sci. Ind. Res.*, 1952, **11B**, No. 7, 307.

## NUCLEAR ENGINEERING CONGRESS

AN International Nuclear Engineering Congress will be held at the University of Michigan in Ann Arbor, June 20-25, 1954. This is the first public meeting of its size devoted entirely to the peacetime uses of the atom. Over a hundred papers and addresses have been scheduled to be presented during the six-day meeting, twelve of which are from authors in Canada, England, Belgium, France, Norway, Italy, Spain and India. The technical programme consists of some ninety papers on the following subjects: materials of construction for reactors, reactor technology, research and

educational reactors, reactor fuel refining and preparation, nuclear power reactors, processing of irradiated materials and applications and uses of radioactive products. In addition to the above there will also be a symposium on 'Education in the Nuclear Field' and an 'Atoms for Peace' exposition featuring radiation, reactor models and instruments. Educational displays will also be held in the galleries of the Rackham Building at the University concurrent with the Congress. Further particulars can be had from Prof. Robert R. White, University of Michigan, Ann Arbor, Michigan (U.S.A.).

# IMPURITIES IN CERTAIN PHOTO-CHEMICAL SYSTEMS INVOLVING RADICALS IN AQUEOUS SOLUTION

## M. SANTAPPA

*Department of Physical Chemistry, University of Madras*

HABER AND WEISS[1,2] explained that the Fenton's reaction of hydrogen peroxide—ferrous ion involved hydroxyl radicals. Kolthoff and Medalia,[3,4] in a study of oxidation of ethyl alcohol by the system, $H_2O_2$-$Fe^{2+}$, established that micro concentrations of inorganic and organic impurities in distilled water or the reagents used in the system gave rise to induced oxidation of ferrous ions. Simultaneously and independently the significance of such impurities in distilled water were recognised by Barb, Baxendale, George and Hargrave,[5] in the oxidation of leuco form of Aeronol brilliant Blue by the Fenton's reagent. In this connection, the work of Fricke and Hart[6,7] who showed long ago that the traces of organic impurities in distilled water could be quantitatively removed only by irradiation with X-rays may also be recalled. A qualitative evidence for the effect of organic impurities in the photochemical system, ion-pair complex, $Fe^{+3}X^-$—Vinyl Monomer, M, where $X^- = OH^-$, $Cl^-$, $N_3^-$ etc. and M = acrylonitrile or methylmethacrylate or methacrylic acid, has been inferred in this paper.

### EXPERIMENTAL AND RESULTS

When the system $Fe^{+3}X^-$-M, is irradiated with ultraviolet light of wavelength 300–400 m$\mu$, the primary photochemical reaction is an electron transfer reaction involving reduction of the cation and oxidation of the anion to a free radical.[8,9] In a secondary reaction free radicals initiate polymerization of the substrate, vinyl monomer. A detailed kinetic study of polymerization with experimental details was presented by Evans, Santappa and Uri[10] and Santappa.[11] Experiments were mostly carried out with 313 m$\mu$. The reaction system, $Fe^{+3}X^-$-M, in aqueous solution has been deaerated by nitrogen purified in Fieser's[12] solution. The intensity of light (I) was determined actinometrically using uranyl oxalate solution. The light absorption fraction, $k_e$, by the ion-pair species was determined spectrophotometrically. After irradiation of the system and filtration of the polymer, the rate of ferrous ion production $(dFe^{+2}/dt)$ was determined colorimetrically using o-phenanthroline as the colouring and complexing agent.

It was observed that the systems, $Fe^{+3}OH^-$-M and $Fe^{+3}Cl^-$-M, gave constant quantum yields

for ferrous ion, 0·05, and 0·13 respectively with big or small concentrations of monomer. The quantum yields in these two cases did not decrease even in the absence of monomer. On the other hand, with the system, $Fe^{+3}N_3^-$-M, a linear variation of quantum yield for ferrous ion with monomer concentration and a maximum quantum yield of 0·5 for high concentrations of the monomer was observed (Fig. 1).
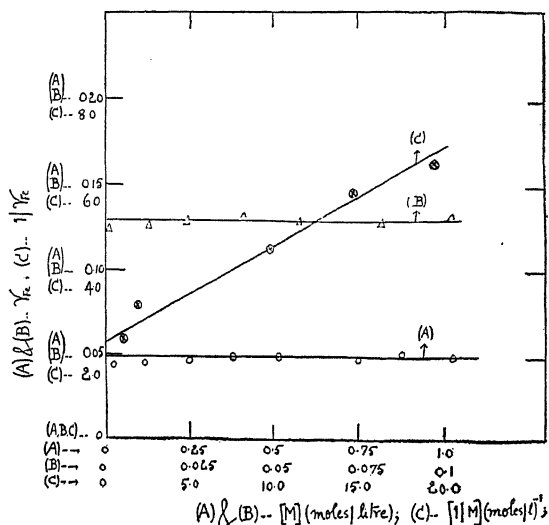


FIG. 1. Graph A represents the invariability of quantum yields for ferrous production $(\gamma_{Fe})$ with monomer concentration in the system $Fe^{+3}OH^-$—acrylo nitrile; Graph B represents the same invariability in the system $Fe^{+3}Cl^-$—methyl-methacrylate; Graph C represents variation of reciprocal quantum yield with reciprocal monomer concentration in the system $Fe^{+3}N_3^-$. acrylo-nitrile at pH = 1 to 11.

The sources from which impurities might be introduced into the reaction system are (1) Fieser's solution which is used to deoxygenate nitrogen which bubbled through the reaction cell. (2) The reagents like water, ferric perchlorate, perchloric acid, hydrochloric acid, sodium azide, etc., which are used in the system.

Three methods of deaeration indicated in Table I by (a), (b), (c) were tried and it is obvious from Table I that it makes a great difference in the rate of ferrous ion production between these methods. It was also observed that the rate of ferrous ion production was

unaffected by change of monomer concentration using either (b) or (c) type of deaeration.

TABLE I

| Method of deaeration | Ion Pair | 313 m$\mu$ ; I = 1·2 × 10⁻⁴ N$h\nu$/hr. $d$Fe$^{+2}$/$dt$ (moles/hr.) ×10⁶ | | 365 m$\mu$ ; I = 7 × 10⁻⁵ N$h\nu$/hr. $d$Fe$^{+2}$/$dt$ (moles/hr.) ×10⁶ | |
|---|---|---|---|---|---|
| | | Monomer | No Monomer | Monomer | No Monomer |
| (a) | Fe$^{+3}$ OH$^-$ | 1·75 | 1·2 | | |
| | Fe$^{+3}$ Cl$^-$ | 3·1 | 2·0 | 1·7 | 1·4 |
| (b) | Fe$^{+3}$ OH$^-$ | 8·0 | 8·0 | 3·7 | 3·7 |
| | Fe$^{+3}$ Cl$^-$ | 1·6 | 1·6 | 9·0 | 9·0 |
| (c) | Fe$^{+3}$ OH$^-$ | 8·0 | 5–8 | 3·6 | 2·8–3·6 |
| | Fe$^{+3}$ Cl$^-$ | 14·0 | 12–14 | 8·2 | 7·6–8·2 |

*(a)* No distilled water or monomer solution between Fieser's solution and reaction cell. *(b)* Distilled water or monomer solution between Fieser's solution and reaction cell. *(c)* Degassing the system by high vacuum.

A few experiments were conducted along lines which facilitated destruction of organic impurities if any in the system and accumulation of ferrous ion, before adding monomer to the system. The solutions containing (1) the ion-pair, and (2) the monomer were first taken in separate compartments of the reaction system which was thoroughly deaerated by (b) or (c) method. Then the compartment containing ion-pair solution alone was irradiated with a strong source of U.V. light and ferrous ion produced was estimated. The monomer solution from the second compartment was added to the already irradiated ion-pair solution and the combined solution was further irradiated. From the total ferrous ion produced it was possible to calculate ferrous ion produced due to various concentrations of monomer (Table II).

TABLE II

Ion-Pair : Fe$^{+3}$Cl$^-$ ; [Fe$^{+3}$] = 10⁻³ M ; [HCl] = 0·5 N

Monomer = Methyl methacrylate

| [M] Molar | Concentration [Fe$^{+2}$] × 10⁴ | | |
|---|---|---|---|
| | Accumulated before adding monomer | Total after adding monomer | due to monomer |
| 0·1 | 0·87 | 3·16 | 2·28 |
| 0·1 | 3·42 | 3·75 | 0·33 |
| 0·1 | 2·06 | 2·73 | 0·67 |
| 0·01 | 2 | 3·56 | 1·56 |
| 0·001 | 1·26 | 4·0 | 2·74 |
| 0 | 0·5 | 0·575 | 0·075 |

It is seen from Table II that the results were not reproducible for the same concentration of the monomer nor is there any regularity in variation of ferrous ion produced with the change in monomer concentration. The only difference in experimental conditions was that different samples of distilled water were used for each experiment. Various types of distilled water, e.g., (a) chemically pure water distilled over KMnO$_4$ and used after a fortnight; (b) water distilled over KMnO$_4$ and used immediately; and (c) conductivity water, were then used in the system, Fe$^{+3}$ Cl-methylmethacrylate, which was irradiated under identical conditions. These gave different values for the rates of ferrous ion production.

DISCUSSION

Assuming stationary concentrations for free radicals which initiate and propagate polymerization ($k_i$ is the rate constant for initiation) one can obtain the following expression for the rate of ferrous ion production,

$$\frac{d\mathrm{Fe}^{+2}}{dt} = \frac{k_s k_\epsilon I}{k_d + k_s} \left( \frac{k_i [M]}{k_0 [\mathrm{Fe}^{+2}] + k_i [M]} \right)$$

where $k_s$ is the rate constant for separation of Fe$^{+2}$X into Fe$^{+2}$ + X; $k_d$ and $k_0$ are constants for the following primary and secondary dark back reactions respectively. I is the intensity of light.

$$\mathrm{Fe}^{+2}X \xrightarrow{k_d} \mathrm{Fe}^{+3}X^-$$

$$\mathrm{Fe}^{+2} + X \xrightarrow{k_0} \mathrm{Fe}^{+3} + X^-$$
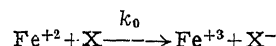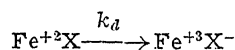
The net quantum yield for ferrous ion production should linearly vary with concentration of the monomer attaining a maximum value represented by $k_s/(k_s + k_d)$ for high concentrations of monomer when $k_i[M] \gg k_0[\mathrm{Fe}^{+2}]$. One possible explanation that suggests itself for the constant quantum yields of ferrous ion with Fe$^{+3}$OH$^-$ and Fe$^{+3}$Cl$^-$ ion-pairs even in the absence of any monomer, is that organic impurities in the system react with hydroxyl or chloride radicals and thus prevent dark back reactions. The assumption of existence of impurities seems justified because varying quantum yields were obtained with different samples of distilled and conductivity waters under identical experimental conditions. The impurities in other reagents in the system, ferric perchlorate, perchloric acid, and hydrochloric acid may also cause these discrepancies. All the reagents, however, have been tested to be free from any oxidising or reducing impurities. On the other hand, by using same sample of water for any set of experiments and using maximum concentration of

monomer it was possible to reduce the interference of the impurities to the minimum. That the azide radicals appear to be particularly stable towards these impurities might be understood by their resonance stabilization among the structures,

$$\cdot \overset{..}{N} = \overset{+}{N} = \overset{..}{N} : \; ; \; \cdot \overset{..}{N} - \overset{+}{N} \equiv N : \; ; \; : \; N \equiv \overset{+}{N} - \overset{..}{N} : \; \cdot$$
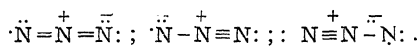
In the absence of monomer, hydroxyl or chloride radicals might be removed from the system by their reaction with impurities, say $RH_2$,

$$RH_2 + OH \text{---} \longrightarrow RH + HOH$$
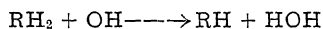
The radicals (RH) formed from impurities may involve in oxidative reactions by either (i) electron transfer reactions, $RH + Fe^{+2} \longrightarrow RH^- + Fe^{+3}$ or (ii) abstraction of hydrogen atoms as indicated for OH radicals above. If electron affinity of the radical RH is high enough, electron transfer oxidation will be preferred whilst a high ionic bond dissociation energy for RH...H favours the oxidation by abstraction of hydrogen atom. If the radicals formed from impurities and those produced from the ion-pair complex are of the same order of electron affinity, then there will be same heat change and equal extents of their reaction with ferrous ion. On the other hand, if the bond dissociation energy OH..H is much greater than RH...H then the following reaction occurs :

$$RHH + OH \longrightarrow HOH + RH$$
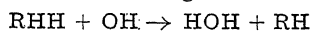
and the difference in the bond dissociation energies is reflected in the exothermicity of the reaction. Another possible way of removal of OH radicals from the system may involve trace of oxygen;

$$RH_2 + OH \longrightarrow RH + HOH$$
$$RH + O_2 \longrightarrow RHO_2 + RO_2$$
$$RO_2 + RH_2 \longrightarrow RHO_2 + RH$$
$$RHO_2 \longrightarrow RO_2$$
$$RO_2 + RH \longrightarrow \text{Non radical products.}$$
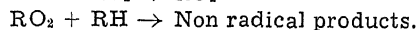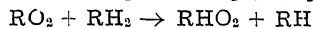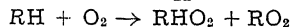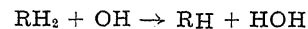
Yet a third possibility of reactions of radicals from impurities may be conceived as represented by the following steps :

$$RH + Fe^{+3} \longrightarrow RH^+ + Fe^{+2}$$
$$RH + Fe^{+3}OH^- \longrightarrow HROH + Fe^{+2}$$
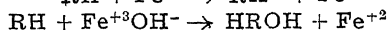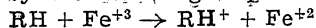
Whether the hydroxyl or chloride radicals would give rise to radicals which would photosensitize illuminated ferric salts and photodecompose water at the intensities used, it is not possible to say with certainty though this might be a useful field for investigation.

Many more possible ways of inter-reactions of radicals and ions obtaining in the system might be proposed depending upon the type of impurity present. A fruitful field in this direction is to get quantitative data on the nature of impurities, the electron affinities of radicals and the ionic bond dissociation energies of the impurities present before more light can be thrown on the reactivities of radicals towards impurities in aqueous solution.

The author is greatly indebted to late Prof. M. G. Evans of Manchester University who first stimulated interest in this work.

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## INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY

A SYMPOSIUM on macromolecular chemistry is to be held during September 27 to October 3, 1954, in Milano and Torino (Italy) under the auspices of the Commission of Macromolecular Chemistry of the International Union of Pure and Applied Chemistry (IUPAC). The subjects for discussion at the symposium are :
(1) Building reactions of macromolecules ;
(2) Transformation reaction of macromolecules;
(3) Block polymers and graft polymers, preparation and properties ; (4) Characterization of synthetic and natural polymers in relation to their practical application : (a) Molecular weight and molecular weight distribution ; (b) Branching and cross-linking ; (c) Crystallisation. Application to read papers at the symposium should be made before May 31 to Prof. Giulio Natta, Instituto Chemica Industriale Politenico Piazza Leonardo da Vinci 32, Milano (Subjects 1-3), and to Prof. Antonio Nasini, Istituto Chimico Universita Corso Massimo D'Azeglio 48, Torino (Subject 4).

# HIGH ALTITUDE ROCKET RESEARCH*

THE liquid-fuelled rocket came spectacularly before the attention of the public towards the close of World War II when the Germans bombarded London from Holland. At the end of the War, the U.S. Army captured about a hundred of these $V_2$ rockets. A large number of them were later used to serve as vehicles to carry instruments up into the high atmosphere for upper air research. Since 1946, other rockets have been developed. The present book by Mr. Newell gives an authoritative review of the research work done in the U.S.A. by various co-operating agencies with the aid of the power-driven rocket. The greatest height so far reached by an instrument-carrying rocket is 389 km., which was attained by a small rocket (WAC Corporal) launched from the nose of a flying $V_2$ rocket.

The development of the rocket as a research tool is an achievement of the first order in the field of upper air research. Let us forget for the time being its war-time uses. Many important phenomena which are observable in the atmosphere, and whose causes were guessed at, or inferred by recondite reasoning, have been cleared up without any obscurity. New facts have been discovered. All this has greatly stimulated thinking about the outer regions of the airy mantle of the earth, and some scientists are even looking forward with confidence to the day when the rocket will be fired out sufficiently far to become a satellite of the earth or land on the surface of the moon or Mars.

Some of the rockets are quite substantial bodies. For example, the $V_2$ rocket is 47' long

* By Homer E. Newell, *Jr.*, Academic Press Inc., 1953. pp. xiv + 298. Price $ 7·50.

and 5½' in diameter. It has space for 44 c.ft. of instruments. Most of the information collected by the instruments are automatically telemetered down to earth by radio signals. Photographic records and air samples are carried down with the rocket to a pre-adjusted height above ground, at which the rocket is made to burst and the released records come down to earth with a parachute.

After an introductory chapter, the author devotes the next two chapters to a detailed description of the rocket and the arrangements for collecting information and recording or telemetering them. The next six chapters he devotes to giving a scientific account of the problems that have been, or are being, investigated with the help of the rocket. These include measurements of pressures, densities, temperatures and winds in the upper atmosphere, of solar radiation in the ultraviolet and soft X-ray regions with spectrographs and photon counters, of atmospheric ozone and its distribution, of the charge densities and strengths of magnetic field in the ionosphere and of some of the properties of cosmic rays before they are transformed, scattered and enfeebled by the earth's atmosphere.

Mr. Newell has a fascinating story to recount and his book on High Altitude Rocket Research is an excellent, authoritative and readable summary of the scientific work that has been carried out by many groups of workers in this borderland between Atmospheric Physics and Astrophysics. Each chapter has a full list of references and the book is provided with both name and subject indices.

K. R. RAMANATHAN.

# GULMARG RESEARCH OBSERVATORY

THE Gulmarg Research Observatory was formally declared open by Prof. A. H. Compton, Chancellor of Washington University, on April 4, 1954. In the course of his address on the occasion, Prof. Compton observed that the altitude of the observatory (9,000') is comparable with most of the high altitude laboratories elsewhere with which it is important to compare results, *e.g.*, Mexico City (about the same magnetic latitude) at 7,500', Huancayo, Peru, at 10,500' Echo Lake, Colorado at 10,000', and Jungfraujoch, Switzerland at 11,300'. The location is also suitable as a base station for work at higher altitudes, up to 11,000' Khillan Marg, 1 hour distant, and up to

14,000' at Apharvat, 3 hours distant. These locations are as high as any station at which high altitude research is now regularly being done.

The establishment of such a high altitude observatory where it can be operated by Indian scientists is of especial importance in providing an opportunity for significant contributions to the advance of science and for training competent scientists. He added that Indian science and in particular the Universities of Aligarh and of Jammu and Kashmir are fortunate to have this laboratory which is an asset to India and to the scientific world.

# LETTERS TO THE EDITOR

## PHOTOELASTIC BEHAVIOUR OF AMMONIUM CHLORIDE

THE photo-elastic behaviour of some cubic crystals was critically examined by Mueller.[2] He found that TlCl, NaCl, CsCl and KCl are different from one another in regard to their photoelastic properties. Unlike several other cubic crystals, $NH_4Cl$ presents an interesting example in its lattice structure. Below the transition temperature, it belongs to CsCl group and above that temperature, it changes to NaCl group.

The author's experimental work has given the following values of the piezo-optic and elasto-optic constants of $NH_4Cl$ (for $\lambda = 5893$Å).

$$(q_{11} - q_{12}) = -3 \cdot 06 \times 10^{-13}; \quad q_{44} = 3 \cdot 63 \times 10^{-13};$$
$$q_{11} = 1 \cdot 91 \times 10^{-13}; \quad q_{12} = 4 \cdot 89 \times 10^{-13}.$$
$$(p_{11} - p_{12}) = -9 \cdot 73 \times 10^{-2}; \quad p_{44} = 2 \cdot 47 \times 10^{-2};$$
$$p_{11} = 14 \cdot 49 \times 10^{-2}; \quad p_{12} = 23 \cdot 97 \times 10^{-2}.$$

At laboratory temperature, $NH_4Cl$ thus behaves as a negative uniaxial crystal when stressed along a cube axis ($p_{11} - p_{12} = -0 \cdot 097$). When stressed along a cube diagonal, it becomes a positive uniaxial crystal ($p_{44} = 0 \cdot 25$). This is what is to be expected because it belongs to the CsCl group. Since the structure of $NH_4Cl$ changes to NaCl group above the transition temperature, it will be interesting to see if ($p_{11} - p_{12}$) continues to be negative while $p_{44}$ also becomes negative.

For ammonium chloride, when a stress is applied along $[\bar{2}11]$ and the direction of observation is along $[01\bar{1}]$ the axes of bifringence make an angle $\theta$ with the stress axes (Bhagavantam[1]), given by the relation

$$\tan 2\theta = 2 \ \sqrt{2}(A - q_{44})/(A + 5q_{44}),$$

where $A = (q_{11} - q_{12})$.

This result has been verified experimentally and the observed value of $\theta$ is 22°, in close agreement with the value calculated from the experimentally determined values of the stress-optic constants.

Another observation made in the course of the present investigation is that for stresses beyond 0·5 kg./mm.² along any direction other than a cube edge, single crystals of ammonium chloride become plastic and show residual birefringence even after the stress is removed.

A full report of the investigations will be published elsewhere in due course.

The author's grateful thanks are due to Dr. S. Bhagavantam for his kind interest in the work.

Physical Labs.,          T. S. Narasimhamurty.
Osmania University,
Hyderabad-Deccan-7,
*March* 5, 1954.

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## SOME NUCLEAR MODELS FOR HIGH ENERGY ELECTRON SCATTERING

Recently, the experimental differential scattering cross-sections for the nuclear scattering of 150 Mev. electrons by tantalum and 125 Mev electrons by gold and lead have been obtained by Hofstadter, Fechter, and McIntyre[1] To correlate this data, the following nuclear density distributions have been proposed by Schiff[2]:—

$$\rho_1(r) = \bar{\rho}_1 exp\,[-(r/a_1)^2] \qquad (1)$$
$$\rho_2(r) = \bar{\rho}_2 a_2^4/(a_2^2 + r^2)^2 \qquad (2)$$
$$\rho_3(r) = \bar{\rho}_3 exp\,[-r/a_3] \qquad (3)$$
$$\rho_4(r) = \bar{\rho}_4\,[1 + (r/a_4)\,exp\,[-r/a_4] \qquad (4)$$

Schiff has obtained the most appropriate parameters for these models from the point of view of the above electron scattering. He has also calculated the electrostatic energy for such charge distributions. One can discard the first two models because they give about twice the required value for this energy. However, the remaining two models give this energy only a

few per cent. higher than the required value. These models, therefore, require further consideration.

On the basis of a correlation between the nuclear shell numbers and the nuclear density proposed by Born and Yang,[3] one obtains for the neutron or proton shell numbers

$$N_l = A\,(l + 3/2)^3/3\pi^2 r_m{}^3\rho\,(r_m)$$

where $r_m$ is the value of $r$ where $r^3\rho(r)$ is a maximum. The empirical shell numbers are obtained provided one takes $r_m{}^3\rho(r_m)/A = 0\cdot112$. We have used this criterion to test the suitability of the remaining two models.

On normalisation we have

$$8\pi\bar{\rho}_3 a_3{}^3 = A; \quad 32\pi\bar{\rho}_4 a_4{}^3 = A$$

and using these conditions we obtain

$$r_m{}^3\rho_3\,(r_m)/A = 0\cdot053$$
$$r_m{}^3\rho_4\,(r_m)/A = 0\cdot059.$$

These values are independent of the respective parameters of the two models.

On the basis of the above considerations, it is concluded that these models also are unsuitable. Similar investigations on other nuclear models are now in progress, the results of which will be published later.

M. G. Science Institute,          N. J. Patel.
Navarangpura,          K. M. Gatha.
Ahmedabad-9, *March* 13, 1954.

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## EMPIRICAL RELATION FOR A VIBRATION FREQUENCY OF MONO-DERIVATIVES OF BENZENE

In the mono-derivatives of benzene, the vibration $\nu_{18}e_{2g}$ (606) of benzene splits into an $a_1$ component and a $b_1$ component. In the ground state the $a_1$ component has been represented[1] by a simple formula involving only the mass of the substituent. The $b_1$ component is known[1-9] to be in the neighbourhood of 615 cm.⁻¹ In the first excited singlet electronic level, which corresponds to the $^1B_{2u}$ level of benzene, the $b_1$ component is known[1-9] to be in the neighbourhood of 520 cm.⁻¹ and the $a_1$ component $('\nu'_{18}a_1)$ can be represented by the following empirically derived relation analogous to the one for the ground state,

$$'\nu'_{18}a_1 = 1782\,[(1/X) + (1/78)]^{\frac{1}{2}}\,\text{cm.}^{-1}$$

where X is the weight of the substituent (on atmoic weight scale). The relation holds for $X \geqslant 15$. The ratio of the corresponding factors

in the two formulæ, *i.e.*, $(1782/1980) = 0.9$, shows that the frequency of the $a_1$ component in the excited state is about nine-tenths of that in the ground state. A comparison of calculated values with observed ones is shown in Table I.

TABLE I

*Comparison of calculated and observed values of $'\nu'_{18}a_1$*

| Molecule | Weight of X | $'\nu'_{18}\ a_1$ | |
|---|---|---|---|
| | | Cal. | Obs. |
| Toluene[2] | .. 15 | 502 | 456 |
| Aniline[3] | .. 16 | 489 | 492 |
| Phenol[4] | .. 17 | 477 | 475 |
| Fluorobenzene[5] | .. 19 | 455 | 451 |
| Benzonitrile[6] | .. 26 | 403 | 406 |
| Benzaldehyde[7,8] | .. 29 | 388 | 400 |
| Chlorobenzene[9] | .. 35 | 363 | 372 |

Dept. of Spectroscopy,        SATYA NARAIN GARG.
Banaras Hindu University,
*October 27, 1953.*

1. Garg, S. N., *Curr. Sci.*, 1953, **22**, 298.
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# HEAVY MINERALS OF CHARNOCKITES AND LEPTYNITES

THE importance of the study of the accessories of igneous and allied rocks has been dealt with and illustrated in a series of interesting papers by Groves,[1] Taylor[2] and Reed,[3] among others.

The heavy minerals of four charnockites (two basic, and one each of the intermediate and acid varieties) and two leptynites from the hills near Padmanabham, about 10 miles from Bhimilipatam in Visakhapatnam District, have been studied following mainly the methods suggested by Groves.[1] Sphene, not found in the thin sections of the respective rocks, has been observed in the heavy mineral mounts of the basic and acid charnockites and the leptynites. The occurrence of grains of sillimanite and monazite in the heavies of the leptynites is also noteworthy.

The percentages of the various minerals in the different rock specimens studied, together with their index figures (the percentage of the total heavies in the respective samples) are given in Table I.

TABLE I

| | Charnockites | | | | Leptynites | |
|---|---|---|---|---|---|---|
| | Basic I | Basic II | Intermediate | Acid | I | II |
| Index figure | .. 51·3 | 55·5 | 36·8 | 23·6 | 28·7 | 26·9 |
| Zircon | .. 2·0 | 1·7 | 3·0 | 6·3 | 4·7 | 6·0 |
| Apatite | .. 1·3 | 1·7 | 7·3 | 4·7 | 3·0 | 3·3 |
| Sphene | .. 1·7 | 1·3 | .. | 2·7 | 3·3 | 3·7 |
| Monazite | .. .. | .. | .. | .. | 2·0 | 2·3 |
| Hypersthene | .. 44·0 | 45·0 | 58·0 | 75·3 | 27·7 | 36·0 |
| Hornblende | .. 11·3 | 19·3 | .. | .. | .. | .. |
| Diopside | .. 28·7 | 23·3 | .. | .. | .. | .. |
| Garnet | .. .. | .. | 25·3 | 6·3 | 32·2 | 25·7 |
| Sillimanite | .. .. | .. | .. | .. | 6·9 | 5·7 |
| Biotite | .. 2·0 | 2·3 | 4·7 | 2·7 | 11·3 | 8·7 |
| Opaque ore minerals | 9·0 | 5·4 | 1·7 | 2·0 | 8·9 | 8·6 |

It is seen that in the charnockites, there is a general decrease of the 'true' accessories towards the basic end, and that the index figures increase with increasing basicity. The leptynites are characterised by a general abundance of the 'true' accessories, and they have the highest percentage of sphene and biotite. According to Groves,[1] the production of these two minerals, in most cases, is increased by assimilation.

Among other features observed are: (1) equidimensional grains are rare; (2) the stout prismatic and the long prismatic grains are more common in the basic rocks, while the short varieties are of frequent occurrence in the intermediate and acid rocks; (3) some grains of the 'true' accessories in the intermediate and acid rocks have corroded margins, while this character is more common with those of the leptynites.

From the observations, the following corroborative assumptions are suggested:

(1) The occurrence of garnets and grains of 'true' accessories with corroded margins in the acid and intermediate charnockites and their absence in the basic type is in accordance with the concept that basic charnockites are magmatic in origin while the intermediate and acid varieties are not pure differentiation products, but have assimilated, in part, the country rock (Khondalites). (2) The presence of sillimanite and the common corroded borders of zircon, apatite and sphene grains in the leptynites,

probably point to their hybrid and interacted nature.

It is significant that the monazites are exclusively confined to the leptynites and are absent from the charnockites. Mahadevan and Sathapathi[5] have suggested the pegmatites cutting through the khondalites as the home of monazite in Viṣakhapatnam area. In this context, the above results are interesting.

I thank Professor C. Mahadevan for his kind interest in these investigations.

Dept. of Geology,          C. SRINIVASA SASTRY.
Andhra University,
Waltair, *February* 4, 1954.

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## FOSSIL HOLOTHUROIDEA FROM THE TRICHINOPOLY CRETACEOUS (S. INDIA)

EARLIER micropalæontological studies[1-4] of the Trichinopoly Cretaceous rocks have stressed their great interest and importance both from the stratigraphic and palæontologic viewpoint. Apart from these, further reports on the fossil algæ are in the press. The latter, when published, are likely to throw light on the evolution of Coralline algæ as commented by Professor Johnson of Colorado School of Mines.

Much more interesting than the facts referred to above, is the occurrence of recognisable remains which are determined as the fossils of Holothuroidea. Their study has led to the conclusion that such fossil remains from this area will help materially in recognising the holothurians. In this region, these objects "are confined to narrow vertical ranges" since rocks from different stratigraphic units have yielded different forms in the Trichinopoly area. In identifying these forms, the paper by Cronies and McCormack[5] has been of great help to the author.

Fig. 1 is a longitudinal section of *Ancistrum* which is recognised only by the "fishhook-like" spicules. The generic description given by Cronies for *Ancistrum* leaves no doubt about the identity of the form. Fig. 2 is another form of the same genus, while Fig. 3 represents a c-shaped body which is considered as a fossil of Holothuroidea by Cronies. Fig. 4 is a trans-

verse section of *Lœtmophasma,* which genus is founded only on the wheel-shaped types. This form represents a stage in the development of such wheel-like plates. All the forms mentioned above come from the Limestone found at Terany.



1 × 100                    2 × 100



3 × 100                    4 × 100



5 × 100                    6 × 50
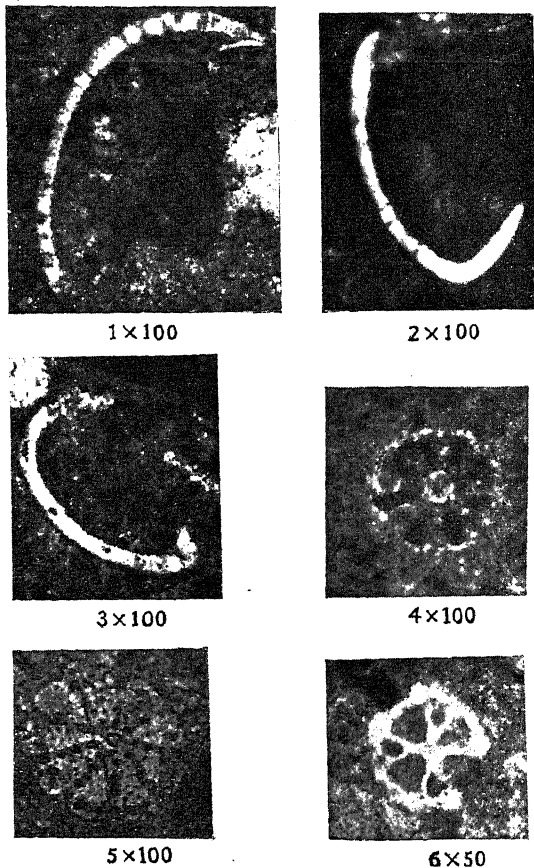
Fig. 6 is a transverse section of *Mesothuria,* a "table" form, which may be either tri- or quadri-radiate. The form shown in the figure is a quadri-radiate type with four large and three smaller radials. The rim of the disc is very well preserved. This form is observed in the Limestone found at Cullygoody.

Fig. 7 is a transverse section of *Zygothuria* which is also an exclusively tri- or quadri-radiate form; the form seen in this figure has only five radials preserved. This form is noticed in the Niniyur cherts of Yellakudumber area.

Fig. 8 shows the very beautiful form, *Myriotrochus,* with the fine arrangement of spokes alternating with "teeth" which are large, flat and project horizontally inward from the rim. The Limestone at Terany has yielded this form.
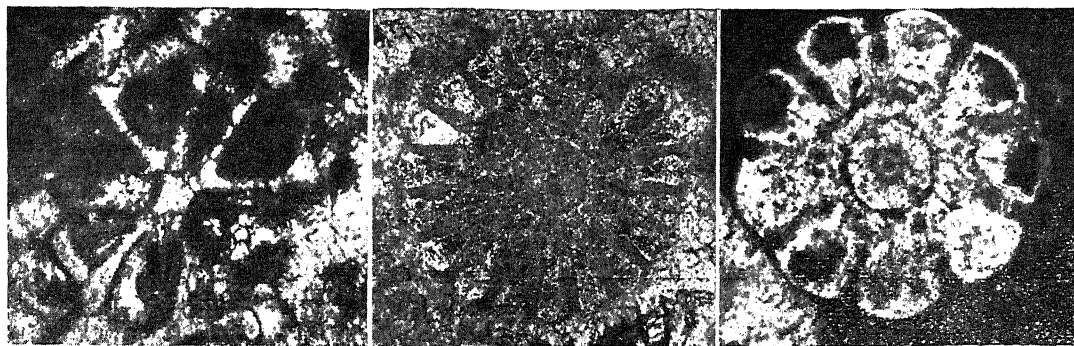
7 × 100                    8 × 100                    9 × 100

Fig. 9 shows a very finely preserved calcareous body which is determined as the fossil of holothuroidea because of the radial arrangement of spokes or radials which do not show any trace of connection with the central cavity, like the branches of Calcareous Siphoneæ do. This wheel-like body is referred, provisionally, to *Chiridota*. This is seen in the Limestone of Naicolum area.



10 × 50

Fig. 10 shows the most abundant and attractive form in the material under study. This is a very fine representative of similar, but specifically different, forms that occur in the different stratigraphic units of Trichinopoly area, though the figured specimen does not show the central perforations. Before being assigned to any one of the three genera—*Protocaudina*, *Chiridota* and *Lætmosphasma*, such forms should be re-examined in view of the critical statement by Cronies (p. 138) that "spicules which might possibly be confused with *P. traquairii* have not yet been reported from either the Mesozoic or Cenozoic sediments". So the value of the study of such forms is increased.

An attempt is made, for the first time in India, to study such fossil remains and to assign them to the Holothuroidea, as others have done outside India. As Cronies predicted long back, they occur in a "number of the Cretaceous formations" in this area.

The author is highly thankful to Professor Rama Rau for his kind encouragement and critical reading of this note, and to Sri. M. G. C. Naidu for his constant interest in the work.

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## GIBLING'S CORRECTION

GIBLING[1,2] has shown that since the interference corrections for $C\big\langle{}^C_C$ and $C\big\langle{}^C_O$ are 2·2 and 2·6 respectively, the interference correction for $C\big\langle{}^C_N$ will be 2·4.

The author has made a rational approach for the calculation of the interference corrections as adopted by Gibling[3] for the calculation of

the interference correction for $C\diagup^C_\diagdown C$ . The group

parachor values for the groups containing C-NH$_2$ and C-OH are calculated from the mean parachor values of aliphatic amines and alcohols, determined by various workers in the field.[4-8] The values are presented in Table I.

TABLE I

| Group or compound | X = NH$_2$ | | X = OH | |
|---|---|---|---|---|
| | Parachor | Difference | Parachor | Difference |
| CH$_3$X | 97·5 | .. | 88·0 | .. |
| (C)CH$_2$X | 82·1 | 15·4 | 72·6 | 15·4 |
| (C)$_2$CHX | 64·5 | 17·6 | 55·0 | 17·6 |
| (C)$_3$CX | 44·7 | 19·8 | 35·2 | 19·8 |

These results indicate that the interference

corrections for $C\diagup^C_\diagdown C$ , $C\diagup^C_\diagdown N$ and $C\diagup^C_\diagdown O$ , as deter-

mined from the parachor values of aliphatic hydrocarbons, amines and alcohols appear to be the same, *i.e.*, 2·2, if the parachor value of hydrogen is taken as 13·2.[3]

Details of the results will be published elsewhere.

The author is grateful to Dr. M. D. Avasare for his kind interest in the work.

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## NOOTKATIN FROM *CUPRESSUS TORULOSA*

*C. torulosa* is an important timber tree of North-Western Himalayas and its wood is considered to be highly durable. Fine shavings of the heart wood were first extracted with cold petroleum ether (b.p. 40-60°), subsequently with cold ether and finally with alcohol. A crystalline tropolone could be obtained from the ether and alcoholic extracts. These were concentrated, the concentrate extracted with aqueous sodium hydroxide and the alkaline extract subsequently acidified with hydrochloric acid. The solid product crystallised from boiling petroleum ether or alcohol as colourless stout rectangular prisms and melted at 94-95° C. The yield from the ether extract was 0·02 per cent. and from the alcoholic extract 0·18 per cent. of the air dry weight of wood. It gave a green copper complex from an ether solution, m.p. 240-42° C. [Found : C, 67·8; H, 7·0; CuO (ash) 15·3; $C_{30}H_{38}O_4Cu$ requires C, 68·5; H, 7·3; CuO (ash) 15·1 per cent.] When treated with hydrogen peroxide (1 mole) in formic acid it gave the monoformate of nootkatin glycol, m.p. 170-71° C. All these properties agreed with those of nootkatin recorded by Erdtman and Harvey[1] who isolated it for the first time from *Chamaecyparis nootkatensis* occurring in Sweden and who also proposed a constitution[1] for this new tropolone More recently Corbett and Wright[2] recorded its isolation from the heartwood of *Cupressus macrocarpa* found in New Zealand.

Dept. of Chemistry,      V. K. AHLUWALIA.
University of Delhi,      T. R. SESHADRI.
Delhi, *February* 9, 1954.

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## INFLUENCE OF CARBON MONOXIDE CHEMISORPTION ON VAN DER WAALS ADSORPTION

IN computing the extent of "free" metal atoms on the surface of iron, cobalt and nickel catalysts, from their adsorption data for carbon monoxide at liquid air temperature, it is assumed that the chemisorbed layer of the gas is not removed by evacuation at − 78° C. and that it has the same capacity for van der Waals adsorption as the bare metal surface.[1,2] Stone and Tiley[3] reported that the chemisorption of carbon monoxide on copper oxide depressed its physical adsorption of krypton at − 183° C. whereas Joy and Dorling[4] experimenting with a promoted iron catalyst found that the existence of a film of chemisorbed carbon monoxide did not affect its adsorption of nitrogen at − 195° C. In view of this discrepancy concerning an important aspect of adsorption processes it was considered desirable to study

under similar conditions the behaviour of a series of kieselguhr-supported cobalt catalysts which have been prepared by us and are under investigation in this laboratory.

Two sets of experiments were performed with each of our catalysts. The first of these consisted briefly as follows: The catalyst was thoroughly reduced with hydrogen at 350° C. and evacuated at the same temperature for 8 hours and was then subjected to the following operations in succession in order to obtain data for the adsorption isotherms shown in Fig. 1:
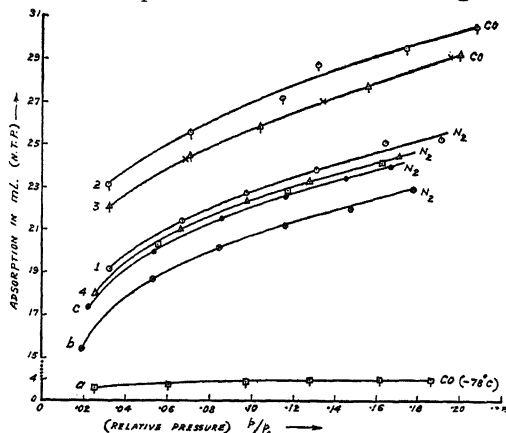


FIG. 1. Adsorption isotherms of nitrogen and of carbon monoxide on cobalt-thoria-magnesia-kiesel-guhr catalyst.

(1) Determination of nitrogen adsorption at — 191° C. (isotherm 1) after which the catalyst was evacuated at $10^{-5}$ mm. for 2 hours at 300° C.

(2) Determination of carbon monoxide adsorption at — 191° C. (isotherm 2) followed by evacuation at — 191° C. for 10 minutes and at — 78° C. for 2 hours.

(3) Repetition of the above run (isotherm 3).

(4) Determination of nitrogen adsorption at — 191° C. followed by evacuation at — 78° C. for 2 hours (isotherm 4).

(5) Determination of carbon monoxide adsorption at — 191° C. followed by evacuation at — 78° C. for 2 hours (isotherm 3, crosses).

(6) Determination of nitrogen adsorption at — 191° C. (isotherm 4, squares).

The catalyst was then evacuated for over an hour, raising the temperature gradually from — 191° C. to + 100° C., and treated with hydrogen at 350° C. for 24 hours. After evacuation at the same temperature for 8 hours, the adsorption experiments enumerated above were repeated in order to check reproducibility.

In the second set of experiments, the reduced and fully evacuated catalyst was treated with

carbon monoxide at — 78° C. up to an equilibrium pressure of 38 cm. (isotherm *a*). It was then evacuated at the same temperature for 2 hours after which the adsorption of nitrogen was determined at — 191° C. (isotherm *b*). The surface was then cleared by evacuation for 2 hours at 300° C. and nitrogen adsorption isotherm determined again at — 191° C. (isotherm *c*). In both these sets of experiments, reproducible results were obtained with each catalyst sample. The data presented in Fig. 1 pertain to the catalyst cobalt-thoria-magnesia-kieselguhr (100 : 6 : 12 : 200), 1·84 g. of which were employed for the experiments.

Two conclusions can be drawn from a scrutiny of the isotherms shown in Fig. 1.

(1) The chemisorption of carbon monoxide at — 191° C. appears to be of two types one of which is much stronger than the other, the relatively weakly chemisorbed carbon monoxide being liberated by raising of temperature to — 78° C. and evacuation of the catalyst, whereas the more strongly chemisorbed gas is retained under the same conditions. This is revealed by the difference in the isotherms (3) and (1) and by (2) and (3) respectively. The quantity of the weakly chemisorbed gas is seen to amount to about 3 ml. whereas that of the strongly chemisorbed gas is about 1 ml. A similar result has been obtained by Joy and Dorling[4] on iron catalyst. The observations of Emmett and Brunauer that chemisorbed carbon monoxide is almost wholly retained under evacuation at — 78° C., therefore, seems to be of limited application.

(2) The physical adsorption of nitrogen is depressed in the presence of a film of chemisorbed carbon monoxide, each ml. of chemisorbed carbon monoxide lowering the nitrogen adsorption by about 0·6 ml. This is evident from the difference between isotherms (2) and (3) and the corresponding difference between isotherms (1) and (4). It is not known to what extent the weakly chemisorbed carbon monoxide lowers the nitrogen adsorption.

No reliable estimate of the extent of carbon monoxide chemisorption can, therefore, be made from these experiments with the cobalt catalysts employed. The difference in volumes of carbon monoxide and nitrogen adsorbed (isotherms 2 and 1) will give a low estimate and a similar comparison of the isotherms 2 and 3 would be still lower.

Further investigations of this problem are in progress and a detailed report will be published elsewhere.

The authors are thankful to Professor K. R. Krishnaswami for his kind interest and encouragement.

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## SUGARCANE WAX

Cane wax is an important by-product of the sugar industry. In India where about 15 million tons of cane are crushed annually, the available wax would be about 12,000 tons valued at some crores of rupees.[1] This crude wax, however, has undesirable properties such as dark colour, stickiness, poor solvent take-up and retention and, hence, it cannot take the place of hard vegetable waxes of the carnauba type which are highly valued in industry. With a view to remedying these defects and utilizing this valuable raw material which at present is wasted, work was undertaken in 1950 at the National Chemical Laboratory on the bleaching and modification of the crude wax.

In view of contradictory reports as to the efficacy of different bleaching agents for the crude cane wax and its unusual resistance to bleaching,[2] a number of bleaching agents, such as bentonite and carbon,[3] chlorine,[4] sulfur dioxide,[5] potassium chlorate[6] and nitric acid,[7] were reinvestigated and a few new ones such as activated alumina, hydrogen peroxide, sodium peroxide, sodium hypochlorite and potassium dichromate were also examined. It was found that potassium dichromate with sulphuric acid was the best. Each pound of crude wax requires about 2·7 lb. of potassium dichromate. Chrome alum as a byproduct is obtained in about a 90 per cent. yield on the basis of the potassium dichromate consumed. This process of one-stage bleaching de-ashes the wax, removes its unsaturation and, under the experimental conditions, hydrolyses a part of the esters and oxidises the free alcohols so formed to the corresponding acids. The bleached wax, having the following constants, is obtained in about an 80 per cent. yield: m.p. 75-79° C.; acid value 125-30; ash content practically nil; saponification value 152; iodine value 1·8. This bleached wax can be sepa-

rated either by a chromatographic procedure or by the method described by Murray and Schoenfeld[8] into its acidic and ester fractions. It consists of 18 per cent. esters and about 80 per cent. acids. It is further chemically modified by esterifying with polyhydric alcohols such as ethylene glycol, when a light-coloured wax of m.p. 78-79° C. and acid value 20-25 is obtained. When this wax is mixed in a suitable proportion with the alkali soap or amides of the bleached wax prepared under carefully controlled conditions, compositions are obtained which have good solvent take-up and retention and which could provide a substitute for hard vegetable waxes of the carnauba type. This process was patented in April 1952 and brought to the notice of Indian sugar manufacturers.[9]

Hatt[10] and co-workers (the abstract of this paper came to our notice by the end of 1951) in Australia have also used chromic acid as a bleaching agent, but our method as described above, differs considerably from theirs. The Australian workers first de-ash the wax with mineral acid and distilled off the lower molecular fraction under reduced pressure, and then bleached the hard wax with chromic acid. They obtained the bleached wax in only about a 50 per cent. yield. As reported by us,[9] the first two stages are not necessary. Now, the Australian workers have come to the same conclusion.[11]

A complete account of this investigation and of the compositions of the crude wax and bleached waxes will appear elsewhere. The authors are grateful to Dr. R. C. Shah for his valuable suggestions during the progress of the work.

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# CALCIUM UPTAKE BY COFFEE POWDER

DURING the course of our investigations on the effect of hardness of water on the cup quality of coffee, we observed that the flavour of coffee is not much influenced by the hardness or otherwise of the extracting water. Hard water, which as such was unacceptable as potable water, when used for brewing coffee, gave a decoction which was considered acceptable by the taste panel. This observation led us to the present investigation on the water-softening properties of coffee powder.

According to Rode[1,2] products with water-softening properties can be prepared by treating finely ground coffee with various reagents. More recently Ramakrishnan *et al.*,[3] have prepared an ion exchange material from coffee husks by treatment with sulphuric acid, sodium chloride and alum. No work on the water-softening properties of untreated coffee powder has so far been reported.

5 per cent. $w/v$ brews of roasted coffee powder (Plantation A) were prepared using distilled water, sample of well water and calcium chloride solution. Calcium was estimated in the water samples used and in the ash obtained from the brews by ammonium oxalate precipitation and titration with $N/100$ $KMnO_4$. The spent coffee powder after extraction was dried, ashed and the calcium in it was determined to estimate the calcium uptake by powder. The results are given in Table I.

TABLE I

*Calcium uptake by coffee powder during brewing*

(5 g. powder + 100 ml. water)

| Brewing media | Calcium content (mg.) | | | |
| --- | --- | --- | --- | --- |
| | Coffee powder | Brewing medium | Decoction | Spent coffee powder |
| I Well water | 5·84 | 18·48 | 11·36 | 12·96 |
| II Well water + CaCl₂ | 5·84 | 21·76 | 12·96 | 13·96 |
| III Distilled water | 5·60 | ·· | 0·80 | 4·80 |

From the above table, it can be seen that coffee powder adsorbs calcium from the water used for brewing. The possible adsorption capacity of the coffee powder for other metals and fluorine as well as the nutritional implication of the metal binding property of coffee powder are under study.

Our thanks are due to Dr. V. Subrahmanyan for his kind interest in the work and to the Indian Coffee Board under whose auspices this work was conducted.

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Res. Institute, Mysore,
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# A PHOTOELECTRIC METHOD FOR THE RAPID DETERMINATION OF MOISTURE IN BIOLOGICAL MATERIALS

IN the course of our investigations on the determination of moisture in dehydrated samples of fruit pulps, we had occasion to use a number of methods for the estimation of moisture so that we could have a quick method for the control of the dehydration process. Methods available so far, namely, drying at 70° C. in a vacuum oven, use of Fischer reagent, toluene distillation method, etc., are rather tedious or time-consuming. Since the rapidity of the method is a very important consideration in the control of the dehydration process of fruits and vegetables, the dichromate oxidation technique recommended by Launer and Tomimatsu[1] was studied to find out its suitability for the purpose. A modification of this procedure was found to yield results in a very short time. Thus, after oxidation of the organic substance in the material with dichromate and sulphuric acid, the resulting yellowish green colour of the solution is measured on a Klett Summerson Photoelectirc Colorimeter using the 66 m$\mu$ red filter. A standard curve is drawn connecting the weight of the material taken and the resulting reading on the colorimeter. This curve is reproducible in the case of any one material. It can be re-drawn on the basis of 100 per cent. dry material, by determining the moisture accurately in the sample taken by means of a standard reference method such as drying in vacuum at 70° C. for 6-7 hours. Making use of this standard curve, it is possible to determine the weight of dry matter content in the sample taken and thereby deduce its moisture content. The whole series of operations, including weighing of material, oxidation with dichromate and measurement of colour on the

colorimeter can be completed in about 10-15 minutes.

0·1-0·3 g. of the finely divided material is weighed and made into a fine slurry with a known small quantity of water (4-5 ml.) in the case of tough materials like dried mango pulp, etc. To this slurry 25 (or 50) ml. standard dichromate solution (1·835 N) followed by 40 ml. concentrated sulphuric acid are added and the beaker allowed to stand for about 3-5 minutes to complete the oxidation. A small portion of the reaction mixture in a test tube is then cooled quickly to room temperature under running water and its colour measured on the photoelectric colorimeter. The weight of dry matter corresponding to the colorimetric reading is read off from the standard curve.

The method was applied in the case of mango pulp and papaya pulp at different stages of the process of dehydration in a cabinet dryer. From the standard curves showing the relation between the dry weight of the material taken and the colorimeter reading, the dry matter content of the pulp was determined by interpolation. The values for moisture content compared well with those obtained by drying the corresponding lots of pulp in an electric oven at 55° C. for 72 hours (Table I). Using a set of six replicate samples for the estimation of moisture, the standard error of the mean of the colorimeter readings was found to be very low (*e.g.*, 274 ± 1·49 and 262 ± 1·29 in two typical experiments) showing that the method is highly reproducible.

TABLE I

*Determination of moisture in mango and papaya pulps during dehydration*

| Stage of drying | Mango pulp | | Papaya pulp | |
|---|---|---|---|---|
| | Moisture per cent. | | Moisture per cent. | |
| | By dichromate method | By oven method | By dichromate method | By oven method |
| I | 66·9 | 68·9 | 80·0 | 81·5 |
| II | 36·8 | 38·0 | 72·6 | 70·4 |
| III | 18·0 | 18·4 | 41·4 | 39·1 |
| IV | 8·3 | 9·5 | 29·1 | 26·5 |

Preliminary experiments indicate that this method may be applicable in the case of materials rich in protein and sugar. Experiments are in progress to study the effect of interfering substances like sulphites, etc., on the accuracy of the method.

The authors' thanks are due to Dr. V. Subrahmanyan for his keen interest in this investigation.

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Mysore, *February* 15, 1954.

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## CONVENIENT SYNTHESIS OF SOME ANTHRACENE DERIVATIVES

FRIEDEL-CRAFTS alkylation with unsaturated ketones and esters forms a novel and convenient route to polycyclic hydrocarbons.[1] This method was further extended to a study of the reactions of tetralin with ethyl allylacetate and allylacetone. In view of a recent publication of Mosby[2] which touches some of our common grounds, we place on record our observations in this regard.

Tetralin was reacted upon with ethyl allylacetate in the presence of aluminium chloride at 0-5° when the ester (I), b.p. 174-75°/8 mm. was obtained in 85 per cent. yield. The ester was quantitatively hydrolysed with alcoholic potash to the corresponding acid (II), b.p. 196-98°/6 mm., S-benzyl-isothiuronium salt, m.p. 124°. (Calculated for $C_{23}H_{30}O_2NS$: N, 7·03; Found: N, 6·75). This acid on cyclisation by Johnson's inverse process[3] gave the ketone (III), b.p. 175-77°/10 mm. in 80 per cent. yield; 2, 4-dinitrophenylhydrazone, m.p. 208° [Lit. (2) m.p. 209°]. (Calculated for $C_{21}H_{22}N_4O_4$: N, 14·21; Found: N, 14·10); Semicarbazone m.p. 203° [Lit. (2) m.p. 202-03°]. (Calculated for $C_{16}H_{21}N_3O$: N; 15·5; Found: N, 15·9). The ketone on reduction (Clemmensen) followed by dehydrogenation with palladised charcoal yielded 1-methyl anthracene (V); picrate (red needles), m.p. 114° [Lit. (4) m.p. 113-15°]. (Calculated for $C_{21}H_{15}O_7N_3$: N, 9·97; Found: N, 9·7).
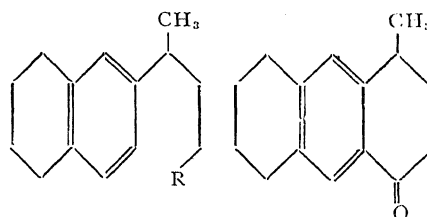


I R=COOC₂H₅       III

II R=COOH

VI R=CO—CH₃

VII R=HOCH—CH₃

IV R = H

VIII R = CH₃

V R = H
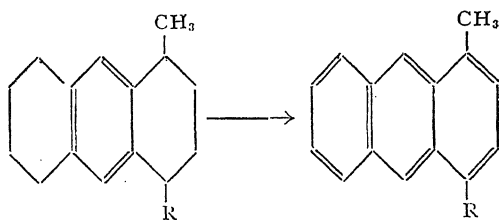
IX R = CH₃

Similarly tetralin was subjected to aluminium chloride catalysed reaction with allylacetone to furnish the ketone (VI), b.p. 190-92°/mm. in 75 per cent. yield. It was reduced with sodium and moist ether to the carbinol (VII), b.p. 155-57°/4 mm. which was cyclised with concentrated sulphuric acid to the tetrahydroanthracene derivative (VIII), b.p. 146-47°/4 mm. in satisfactory yield. Compound VIII was dehydrogenated to 1, 4-dimethylanthracene (IX) with palladised charcoal, picrate m.p. 140° [Lit. (2) m.p. 139-40°]. Microanalyses by Drs. Weiler and Strauss, Oxford.

The details will appear elsewhere.

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*March* 5, 1954.

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# SYNTHESES OF 2:9-DIMETHYL-, 2:9:3-TRIMETHYL-, AND 2:9:2′: 4′-TETRA-METHYL-3:4-BENZPHENANTHRENE

EVER since Cook, Kennaway and their associates[1] demonstrated that 3:4-benzphenanthrene is a potent carcinogen, a number of synthetic routes to this hydrocarbon and its derivatives have been developed. One such method, developed by Mukherji, Gaind and Rao,[2] has now been extended further to the syntheses of certain polyalkyl-3 : 4-benzphenanthrenes.

4-Methyl-1-tetralone[3] was formylated[4] to obtain 2-hydroxy-methylene-4-methyl-1-tetralone (I) in 80 per cent. yield, b.p. 145-46°/6 mm. This on allylation with allyl iodide, followed by hydrolysis[2] with 5 per cent. KOH at 50-55°,

yielded 2-allyl-4-methyl-1-tetralone (II), b.p. 140-42°/2 mm., $\eta_D{}^{35}$ 1·5372, 2 : 4-Dinitrophenyl-hydrazone, m.p. 205-06° (Calculated for $C_{20}H_{20}N_4O_4$ : N, 14·7; Found: N, 15·2). 2-Allyl-4-methyltetralone was then subjected to aluminium chloride catalysed[2] reaction with thiophene-free benzene, when 2-[β-methyl-β-(phenyl)-ethyl] 4-methyl-1-tetralon (III, $R_1 = R_2 = R_3 = H$) was obtained in 64 per cent. yield, b.p. 208-10°/1 mm. Ponndorf reduction of the above ketone proceeded smoothly to afford an 83 per cent. yield of the corresponding carbinol (IV, $R_1 = R_2 = R_3 = H$), b.p. 196-200°/2 mm. This carbinol on cyclisation with concentrated sulphuric acid[5] gave 2 : 9-dimethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_1 = R_2 = R_3 = H$), in 85 per cent. yield, b.p. 206-10°/2 mm. Dehydrogenation of the latter product with palladium charcoal (30 per cent.) at 300-20° for 4 hours proceeded smoothly to yield 2 : 9-dimethyl-3 : 4-benzphenanthrene (VI; $R_1 = R_2 = R_3 = H$), m.p. 130° (Lit.[6] 130·6-31°), picrate, m.p. 162° (Lit.[6] 164·6-65°). (Calculated for $C_{26}H_{19}N_3O_7$ : N, 8·66; Found: N, 8·60).



(I)



(II)



(III)

(IV)



(V)



(VI)
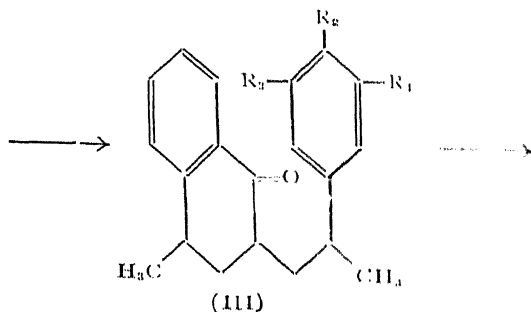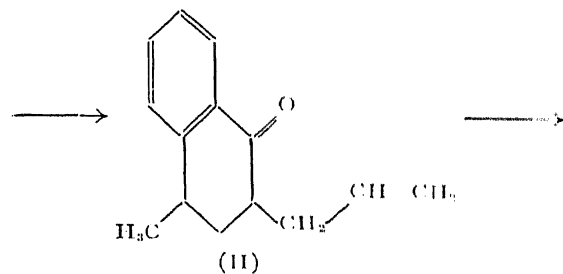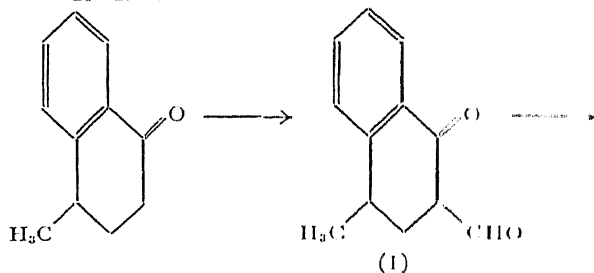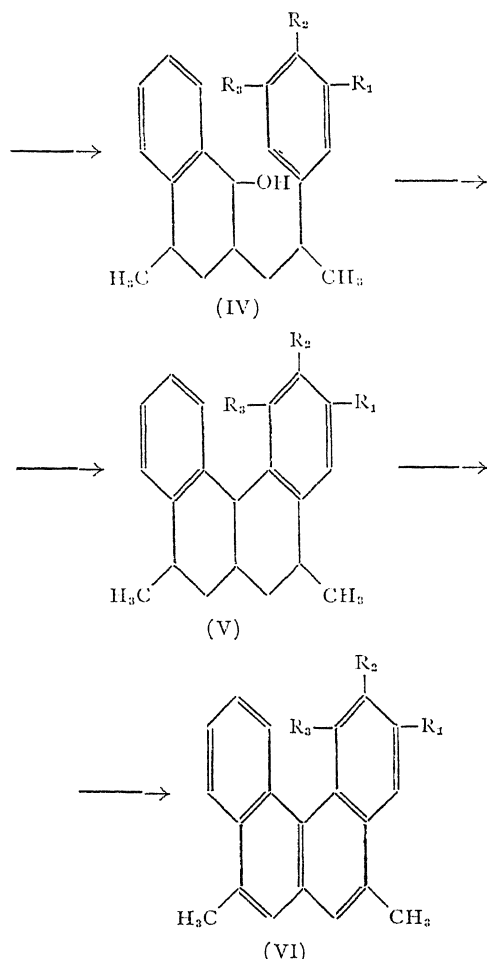
Similarly, 2-allyl-4-methyl-1-tetralone when subjected to Friedel-Crafts reaction with toluene, gave 2-[$\beta$-methyl-$\beta$-($p$-tolyl)-ethyl]-4-methyl-1-tetralone (III; $R_1 = R_3 = H$; $R_2 = CH_3$), b.p. 198-202°/1 mm. $\eta_D^{31}$ 1·5582, in 64·6 per cent. yield. The *para*-orientation in the above Friedel-Crafts product was established through its alkaline permanganate oxidation to a mixture of phthalic acid and terephthalic acid which were separated by fractional crystallisation from water. Terephthalic acid was identified as its dimethyl ester, m.p. 140°. The above tetralone, on reduction with aluminium isopropoxide afforded 83 per cent. yield of the corresponding tetralol (IV; $R_1 = R_3 = H$; $R_2 = CH_3$), b.p. 204-10°/3 mm., $\eta_D^{33.6}$ 1·5544. This tetralol on cyclisation with concentrated sulphuric acid gave 2 : 9 : 3′-trimethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_1 = R_3 = H$; $R_2 = CH_3$), in 80 per cent. yield, b.p. 200-02°/3 mm., $\eta_D^{33.6}$ 1·5734. Dehydrogenation

of this hexahydro derivative with palladium charcoal (30 per cent.) yielded 2 : 9 : 3′-trimethyl-3 : 4-benzphenanthrene, m.p. 91°. (VI; $R_1 = R_3 = H$; $R_2 = CH_3$). (Calculated for $C_{21}H_{18}$ : C, 93·3; H, 6·66; Found: C, 92·7; H, 6·63; picrate m.p. 140°). (Calculated for $C_{27}H_{21}O_7N_3$; N, 8·41; Found: N, 8·25).

Again, aluminium chloride catalysed reaction of 2-allyl-4-methyl-1-tetralone with *m*-xylene gave 2-[$\beta$-methyl-$\beta$-(*m*-xylyl)-ethyl]-4-methyl-1-tetralone (III; $R_2 = H$; $R_1 = R_3 = CH_3$) in 62 per cent. yield, b.p. 218-22°/2 mm. The *meta*-orientation in this case was proved by the alkaline permanganate oxidation of the above tetralone to phthalic acid and trimesic acid which were separated due to the insolubility of trimesic acid in water. The trimethyl ester of trimesic acid melted at 142° (Lit.[7] m.p. 144°). Ponndorf reduction of the Friedel-Crafts product afforded 80 per cent. yield of the corresponding tetralol (IV; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 210-12°/3 mm., $\eta_D^{34.8}$ 1·5563. Cyclisation of the above tetralol with concentrated sulphuric acid yielded 2 : 9 : 2′ : 4′-tetramethyl-1 : 2 : 9 : 10 : 11 : 12-hexahydro-3 : 4-benzphenanthrene (V; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 198-200°/2 mm., $n^{33}$ 1·5738. The hexahydro derivative on dehydrogenation with palladium charcoal at 300-20° gave 2 : 9 : 2′ : 4′-tetramethyl-3 : 4-benzphenanthrene (V; $R_2 = H$; $R_1 = R_3 = CH_3$), b.p. 200-05°/2 mm.; picrate, m.p. 150°. (Calculated for $C_{28}H_{23}O_7N_3$; N, 8·18; Found: N, 8·06).

Microanalyses by Drs. Weiler and Strauss, Oxford.

ISHWAR CHANDRA LAKHUMNA.<br>V. S. GAIND.<br>S. M. MUKHERJI.<br>Dept. of Chemistry,<br>Panjab University,<br>Hoshiarpur,<br>*March* 9, 1954.

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## OCCURRENCE AND BREEDING OF *PAMA PAMA* (HAMILTON) IN FRESHWATERS

FRY and fingerlings of *Pama pama* (Hamilton) were collected in fairly large numbers (about 564 specimens ranging in total length from 10-76 mm.) along with those of carps and cat-fishes in the fry collection nets, during the south-west monsoon months of 1951 and 1952 near Mokemah Ghat, Dighwara and Buxar on the Ganga and near Khagaria on the Burhi Gandak. Larger specimens of *P. pama,* 160-245 mm. in total length, were also recorded at Buxar in November and December 1952. This is perhaps the first record of the occurrence of *P. pama* in freshwaters far above the tidal influence.

According to Day[2] *P. pama* occurs in the Bay of Bengal entering estuaries and rivers as far as the tide extends. Weber and de Beaufort[5] state that its distribution extends from the Bengal-Orissa coast along Burma and Malaya to Sumatra. Recently Pantulu and Jones[4] describing larval stages of *P. pama* collected from the Hoogly near Barrackpore state that breeding takes place further down the river at the mouth of estuary or in the sea close to the estuary and that the juveniles are brought up by the tide. The post-larvæ and juveniles which are available in large numbers at Barrackpore are present only in small numbers in Shantipur area, which is about 170 miles from the sea.

Mokemah Ghat is situated about 470 miles from the sea and about 300 miles upstream from the Nabadwip-Purbastali area which forms the tidal limit of the Hoogly; Buxar is located still further upstream about 160 miles west of Mokemah Ghat and about 630 miles from the sea. The occurrence of the young and fairly big specimens of this species at places situated so far above the tidal limits of the Hoogly indicates that this fish has successfully acclimatised itself to freshwater conditions. The availability of the fry of this fish in the rivers Ganga and Burhi Gandak during the monsoon months indicates that the breeding time of this fish is the same as that of the majority of other riverine species of fish.

Another estuarine fish which breeds both under salt water and freshwater conditions is the pearl-spot, *Etroplus suratensis* (Bloch.), a brackish water perch indigenous to peninsular India and Ceylon. According to Hora[3] *E. suratensis* is a freshwater fish which has secondarily taken to brackish water. It has so well established itself in the new habitat that the main pearl-spot fishery in South India is in

brackish waters (Alikunhi *et al.*[1]). Some marine and estuarine fishes such as *Chanos chanos* (Forskal), *Lates calcarifer* (Bloch.), *Elops saurus* Linn., *Mugil* spp. are also known to thrive very well in freshwaters. Since *Pama pama* grows up to at least 5′ in length[2] and is now known to occur high up in the Ganga river, it may be worth exploring the possibility of culturing this species in freshwaters.

The occurrence of the fry of *P. pama* in large numbers in the river Ganga far above the tidal limits not only indicates that this fish has acclimatised itself to freshwater conditions but also breeds there.

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V. G. JHINGRAN.

S. J. KARAMCHANDANI.

Central Inland Fisheries
   Res. Sub-Station,
Allahabad, *February* 17, 1954.

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## DOMINANT INHIBITORY FACTOR FOR AWNING IN RICE (*ORYZA SATIVA*)

AWNING in rice is dominant over awnless. In $F_2$, different kinds of segregations were recorded by earlier workers: (*i*) 3 awned : 1 awnless[2,3] signifying monogenic segregation; (*ii*) 9 awned : 7 awnless[1] indicating the operation of complementary factors; (*iii*) 15 awned : 1 awnless being the result of duplicate factors.[4,5] The present note describes the inheritance of awning involving dominant inhibitory factor.

C.28-16, an awnless *indica* from Burma was crossed with Aikoku, an awned *japonica* from Japan. The $F_1$ was awnless, contrary to expectation on the basis of earlier records. Three $F_2$ families were grown and the individuals classified into awned and awnless (Table I).

TABLE I

| No. of the $F_2$ family | | Awnless plants | Awned plants | Total | $\chi^2$ | Probability |
|---|---|---|---|---|---|---|
| I | Observed | 66·0 | 8·0 | 74 | 3·083 | >0·05 |
| | Expected | 60·1 | 13·9 | 74 | | |
| II | Observed | 55·0 | 7·0 | 62 | 2·243 | >0·05 |
| | Expected | 50·4 | 11·6 | 62 | | |
| III | Observed | 80·0 | 9·0 | 89 | 4·370 | >0·01 |
| | Expected | 72·7 | 16·7 | 89 | | <0·05 |

These families conform to a segregation of 13 awnless: 3 awned as would be expected in the presence of dominant inhibitor in one of the parents, in this case the *indica* parent. On this assumption, the genetic constitution of the two parents would be—C.28-16 *an an Ian Ian,* and Aikoku *An An ian ian,* where *Ian* stands for the presence of dominant inhibitory factor, *ian* for its absence, *An* stands for the presence of awn and *an* for its absence. The experiment was repeated for a second season and similar results were obtained.

The expression of awning in rice is much susceptible to environmental conditions. Although the various workers have inferred major gene action determining awning, they have observed certain gradations between different groups of awning indicating the operation of modifiers as well. The existence of dominant inhibitory factors besides the above complicates the inheritance of awning in rice.

Central Rice Res. Inst.,     B. MISRO.
Cuttack-4, *February* 8, 1954.   S. S. MISRO.

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## THE PHARYNGEAL POCKETS AND ITS ASSOCIATED STRUCTURES IN *GADUSIA CHAPRA* (HAM.)

*Gadusia chapra* is a plankton feeder, and its mouth is devoid of teeth. There are four pairs of gill arches, each bearing gill lamellæ on its outer surface and closely-set gill rakers on the inner surface. An additional row of rakers is present on either side of the floor of the pharynx.

There are two pharyngeal pockets which are being recorded in this fish for the first time. Each pocket is a diverticulum of the roof of pharynx and is like a curved horn. It has two parts: (*a*) the canal passage, and (*b*) the sac, the former continuing into the latter. The mesial rakers on the lower limb of the fourth gill arch and the additional row of rakers continue inside along the wall of canal passage. The sac portion of the pocket ends blindly and is devoid of rakers.

Each pocket is supported by and is attached to the epibranchial piece of the fourth gill arch. A cartilaginous extension arising from the ephibranchial piece of the fourth gill arch encapsulates the pocket ventrally and partly dorsally.
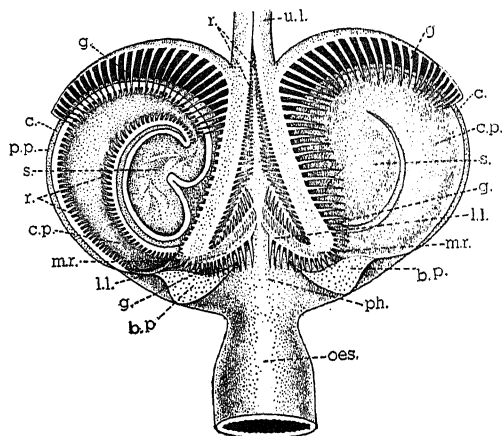


FIG. 1. Diagrammatic representation of the pharyngeal pockets of *Gadusia chapra* (Ham.) seen from the ventral side. Right pocket cut longitudinally to show the continuation of rakers along the wall of the canal passage.
*b.p.*, bony plate; *c.*, cartilage; *c.p.*, canal passage of the pharyngeal pocket; *g.*, gills, *l.l.*, lower limb of fourth gill arch; *m.r.*, mesial rakers on the lower limb of fourth gill arch; *oes.*, œsophagus; *r.*, rakers; *p.p.*, pharyngeal pocket; *ph.*, roof of pharynx; *s.*, sac of the pharyngeal pocket; *u.l.*, upper limb of fourth gill arch.

The pharyngeal pocket has a folded stratified epithelial lining with plenty of mucous cells. A few taste buds are present only in mucosa of the canal passage. Mucosa is followed by submucosa which is made up of connective and adipose tissues. The muscularis is thick and striated, and blood capillaries are present in both the layers.

Hyrtl[1,2] first described the pharyngeal pockets in certain clupeoid fishes and termed these as *die accessorischen Kiemenorgane* or *die Kiemenschnecke.* Ridewood[5] recorded their existence in his work on the clupeoid osteology. Rauther,[4] in the study of accessory respiratory organs in bony fishes, mentioned more or less comparable structures in synbranchids, clupeoids and characinids. Lagler and Kraatz[3] described the pharyngeal pockets in *Dorosoma cepedianum.*

Regarding the function of these pockets, Hyrtl and Rauther have interpreted similar structure in related fishes, as of respiratory significance. Lagler and Kraatz describe the pockets in *Dorosoma* as non-glandular, non-vascular and consider these accessory to the digestive rather than to the respiratory system.

The pharyngeal pockets in *Gadusia*, however, are glandular, secrete mucus and are therefore to be regarded as accessory parts of the alimentary tract.

The pharynx leads into œsophagus which continues into the stomach. The pyloric region of stomach is developed into a gizzard which has a thick muscular wall and a cuticular lining. The gizzard is followed by the intestine and at its place of origin opens the bile duct. There are 100-120 pyloric cæca, which open through 15-25 orifices into the intestine. The intestine runs a circuitous course and terminates at the anus.

The author has also observed pharyngeal pockets in *Hilsa ilisha* (Ham.) and *Chanos chanos* (Forskal). Work on the anatomy and histology of pockets in these fishes is in progress and the observations will be published.

Sincere thanks are due to Dr. M. L. Bhatia for guidance and supervision in this work.

Dept. of Zoology,          B. G. KAPOOR.
University of Delhi,
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## ELATERID GRUBS FROM *CUTANEOUS MYIASIS* IN GOAT

WHILE removing a number of Calliphorid (*Chrysomyia* sp.) maggots from a cutaneous ulcer between the hoofs of a goat at Karaikudi, the author came across a few long wiry grubs actively burrowing deeper and deeper into the living tissues, one of which (Fig. 1)
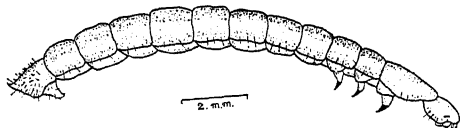


FIG. 1. Elaterid Grub from Cutaneous Myiasis.

was successfully isolated and identified as the larva of an *Elaterid* beetle.

This strange association of Elaterid larvæ with Calliphorid maggots is probably accidental. Still it is interesting to find that these larvæ which usually live in soil, dung and decaying vegetable matter or bore into wood, have adapted themselves to the new and strange

habitat remarkably well. One outstanding modification observed is the lack of sclerotisation and the consequent softness of the integument. The grub appears to be that of the common click beetle, *Agrypnus* sp.

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*March* 6, 1954.

## GAMETOPHYTES OF *VITIS PALLIDA* (W & A.)

*Vitis pallida* is a member of the family Ampelideæ (Vitaceæ). Literature regarding the embryology of vitaceæ is very meagre. Mulay, Nair and Sastry[1] have referred to the relevant literature on this subject. *Vitis pallida* is a tendril climber found frequently in the hilly tracks of the Western Ghats. The material for the present work was collected from Changanacherry (T. C. State) in the month of July 1953 and the following observations were made by the authors.

The development of the floral organs takes place in the sequence—sepals, petals, androecium and gynoecium.

A group of hypodermal archesporial cells appear in the young anther. The mature anther wall comprises the epidermis, fibrous endothecium, ephemeral middle layers, and secretory multinucleate tapetum. Reduction divisions are simultaneous. Cytokinesis occurs by furrowing and the microspore tetrads may be tetrahedral, isobilateral, or decussate. Pollen grains are shed at the three-celled stage (Fig. 1). They are triporate and are of the psilate type.
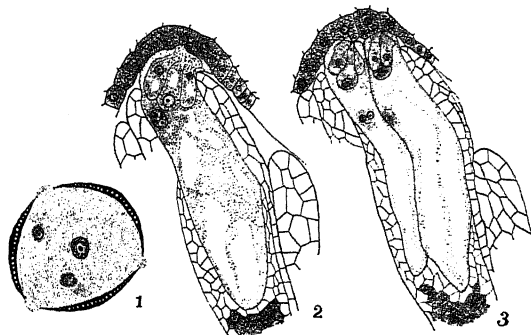


FIG. 1. T.S. of Pollen grain, × 725.
FIG. 2. Mature embryo sac, × 725.
FIG. 3. Two embryo sacs in the same ovule, × 725.

The ovules are bitegmic crassinucellate and anatropous. The micropyle is directed downwards. The deep-seated megaspore mother cell undergoes the usual meiotic divisions to form

a linear tetrad of megaspores of which the chalazzal one functions. Occasionally ovules with two megaspore mother cells also occur. The embryo sac passes rapidly through the 2, 4 and 8 nucleate stages. The apical end of the embryo sac after disorganising the nucellus comes out through the micropyle, extends beyond the ovule, and occupies the little space between the ovule and ovary wall, pressing itself closely to them. The apical end is seen to have penetrated into the abutting epidermal cells of the carpellary wall (Fig. 2). The position of the embryo sac, its thin wall, and the rich contents of the abutting epidermis clearly suggests a nutritive relation. Though protruding embryo sacs have been reported as occurring in many plants, such a condition is very rare in angiosperms.

In one case two mature embryo sacs have been observed to lie side by side in the same ovule. The apical region of both the sacs extend beyond the ovule (Fig. 3). Maheshwari[2] states that multiple embryo sacs may arise (1) either from the derivatives of the same megaspore mother cell, or (2) from two or more megaspore mother cells, or (3) from nucellar cells. It appears that the present case has resulted from the activity of the second megaspore mother cell.

The mature embryo sac shows the normal organisation but the antipodals are ephemeral.

We are greatly indebted to Dr. B. N. Mulay for his valuable suggestion and criticism.

Dept. of Botany,             N. C. NAIR.
Birla College,             V. PARASURAMAN.
Pilani, *February* 10, 1954.

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### PESTALOTIOPSIS PSIDII ON PSIDIUM GUAVA

THE genus *Pestalotia* was first established on the basis of the fungus *Pestalotia pezizoides* de Not. occurring on dead canes of *Vitis vinifera*. Guba[2] confirmed that the species had six-celled spores with hyaline end cells, the apical cell setulate. Patouillard found the fungus on fruits of *Psidium pomiferum* and named it *Pestalotia psidii*. The species has been known to occur on *Psidium guava* in India for a long time.

Patel, Kamat and Hingorani[3] recorded the fungus on fruits at Poona. The writers described the occurrence of the species in Mysore on fruits and leaves of *Psidium guava* along with another fungus *Glomerella psidii* (*Colletotrichum psidii*).

Saccardo[4] created the subgenus *Eu-Pestalozzia* for the forms having spores with hyaline end cells, coloured median cells and two or more apiculate setæ; *Monochœtia* for those with similar spores but unisetulate, and *Pestalozzina* for forms with entirely hyaline conidia. He[5] later elevated the subgenus *Pestalozzina* to generic rank and Allescher[1] did the same for *Monochœtia*. *Pestalotia* was restricted to the subgenus—*Eu-Pestalozzia*.
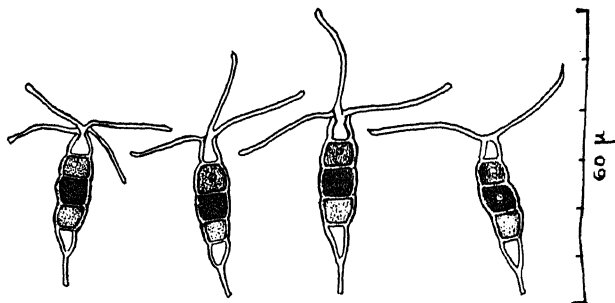


FIG. 1. Camera lucida drawing of conidia from potato dextrose agar culture 30 days old.

Steyaert[6] gave an emended diagnosis of the genus. He reclassified the species and made some new combinations. According to him *Pestalotia* is represented by a single species, *Pestalotia pezizoides*, in which the coloured middle portion of the conidium is divided into four locules by rings forming pseudo-septa and not into four cells by septa. The remaining species are divided into two new genera, *Truncatella* in which the spores are three-septate, and *Pestalotiopsis* in which they are four-septate. He does not accept Saccardo's genus *Monochœtia* comprising the species with unisetulate conidia. The spores of *Pestalotia psidii* described by the writer[8] are spindle-shaped, four-septate, median cells coloured, end cells hyaline, apical cell 2-4 setulate (Fig.). The fungus agrees in general characters with those of the section *Trisetulatœ* of Steyaert.[7] Hence the species *Pestalotia psidii* Pat. occurring on fruits and leaves of *Psidium guava* is now proposed to be named *Pestalotiopsis psidii* (Pat.) Venkatakrishniah, comb. nov.

The writer is greatly indebted to Sri. S. V. Venkatarayan, for kind suggestions.

N. S. Venkatakrishniah.

Plant Pathology Section,

Agric. Department,

Bangalore, *October* 14, 1953.

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## TWO NEW RECORDS OF PHYTO-PATHOGENIC BACTERIA FROM BOMBAY STATE

*Alysicarpus rugosus* DC., one of the best known green fodder for cattle, is an important legume of Bombay State. A leaf-spot and blight inciting disease of bacterial origin was observed at Jalgaon during the rainy season of 1953. On the leaves, the pathogen produces a few, small, round, water-soaked areas, measuring about 0·5-1·0 mm., mostly at the periphery of the leaf. On further development of the disease, these spots with pale yellow parched centre and brown periphery produce blight symptoms in the leaves which turn yellow, curve and shed. Although the blight symptoms progress along the veins, the pathogen does not become vascular. Besides infecting leaves, it produces canker on injured stem. Since no bacterial disease has so far been reported on this host and as the pathogen is restricted to *Alysicarpus rugosus* only, it is proposed to assign the bacterium a new name *Xanthomonas alysicarpi* nov. sp. whose technical description is given below:

Short rods; single, rarely in chains of two; single polar flagellum; 0·6 × 2·0 µ in size; gram negative; capsulated; no endospores; on potato dextrose agar plates, the colonies are circular with entire margin, smooth, shining, convex with no striation, measuring 2·0 cm. after 8 days, colour pale lemon yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised and litmus reduced; ammonia and hydrogen sulphide produced from peptone; nitrite not produced from peptone-nitrate broth;

M.R. and V.P. tests negative; acid with no gas from dextrose, lactose, maltose, and sucrose; no growth in salicin; optimum temperature for growth 27-30° C.; thermal death point about 51° C.; pathogenic to *Alysicarpus rugosus* only.

A new bacterial leaf-spot of *Bridelia hamiltoniana* Wall., a common waste lands shrub growing along the western coast of India was observed at Ambarnath in July 1953. On the rhomboid leaves, the pathogen produces few to numerous minute water-soaked spots visibly clear on the lower surface of the leaves, measuring initially 0·3-0·5 mm., fairly well distributed all over the leaf-surface. High atmospheric humidity and continuous rains are highly congenial for the development of the disease. With the progress of the disease, the spots increase in size to 1·0 mm., become angular and dark brown. Bacterial ooze in the form of small shining beads is found on the underside of the leaves. The pathogen infects leaves only. Since no bacterial disease has so far been reported on this host and the pathogen being specific to *Bridelia hamiltoniana* only, it is proposed to assign the bacterium a new name *Xanthomonas brideliæ* nov. sp. Its technical description is given below :

Short rods; single; single polar flagellum; 0·5 × 1·7 µ in size; gram negative; capsulated; no endospores; on potato dextrose agar plates, the colonies are circular with entire margin, smooth, shining, convex with no striation, measuring 1·8 cm. after 8 days, colour barium yellow; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised and litmus reduced; ammonia and hydrogen sulphide produced from peptone ; nitrite not produced from peptone-nitrate broth; M.R. and V.P. tests negative; acid but no gas from dextrose, lactose, maltose and sucrose; no growth in salicin; optimum temperature for growth 27-30° C.; thermal death point about 51° C.; pathogenic to *Bridelia hamiltoniana* only.

Fuller details will be published elsewhere.

Plant Pathological Lab.,          V. V. Bhatt.

Agric. College, Poona,          M. K. Patel.

*February* 16, 1954.

## THE ANTIPODALS IN THE FAMILY AMARANTHACEAE

In the April issue (1954) of this Journal, Bakshi[2] has published a note on "The Antipodals in the Family Amaranthaceae". He says he has failed to confirm my previous observations in respect of the multiplication of the

antipodals in *Pupalia lappacea.* Bakshi's findings prompted me to re-examine my old slides. The results of rechecking confirm my original observations.

As previously reported by the author[4] the antipodals in *Pupalia lappacea* do multiply to form a small mass of cells which in its capacity to stain more deeply differs markedly from the surrounding tissue of the nucellus. Secondly the nucleoli, in general, of the antipodals are bigger and are more conspicuous than those seen in the nuclei of the neighbouring nucellar cells. Such differences would hardly ever arise when, to quote Bakshi, "in an oblique section a few cells of the perisperm are cut off in such manner that they appear to be embedded in the cavity of the embryo sac".

The cells of the perisperm which Bakshi suggests, appear embedded in the cavity of the embryo sac would naturally be expected nearer the concave side of the embryo sac. I have, however, seen such multiplying antipodals in many cases nearer the convex side of the embryo sacs cut in median plane, which precludes even a distant possibility of perisperm cells appearing embedded in the cavity of the embryo sac. My Fig. 14 *g*[4] is significant. It is sketched from a median section. It shows one enlarged and vacuolated, and four small antipodals. Such enlarged and vacuolated antipodals are also noted by Bakshi. It would be incorrect to conclude from this figure that four small antipodals are the cells of the nucellus along with one enlarged antipodal.

At a stage when the embryo sacs become 300-400 microns in length, the antipodals are situated at a distance of about 150-200 microns from the micropylar end of the embryo sac. Such a regular spacing of what Bakshi regards as nucellar cells would be beyond all comprehension.

During the early stages of embryo development the degenerating antipodals appear as darkly stained structures. Could it happen with the perisperm cells which Bakshi suggests, might appear embedded in the embryo sac?

An increase in the number of antipodal cells has been observed in several families of the Centrospermales like the Nyctaginaceae,[3,6,7] Chenopodiaceae[1] and Phytolaccaceae.[5] In respect of this feature then the case of *Pupalia lappacea* would bring the Amaranthaceae in line with the other families of this order. Embryological investigations on several species of the Amaranthaceae are in progress and the subject would be discussed fully elsewhere, but let us not in the meanwhile compel the Amaranthaceae to follow a rigid sequence of development in having only three antipodals.

M.A.C.S. Laboratories,  L. B. KAJALE.
Law College Buildings,
Poona 4.
*April* 30, 1954.

1. Artchwager, E. and Starrett, R. C., *Jour. Agri. Res.*, 1933, **47**, 823-43.
2. Bakshi, T. S., *Curr. Sci.*, 1954, **23**, 128-29.
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5. —, 1954 (in press).
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## CENTRAL SALT RESEARCH INSTITUTE, BHAVNAGAR

THE Central Salt Research Institute, Bhavnagar, was declared open by the Prime Minister, Pandit Jawaharlal Nehru, on April 10, 1954.

In view of the facilities offered by the Saurashtra Government for the establishment of the Institute, the Council of Scientific and Industrial Research decided to set up the Institute at Bhavnagar. Efforts are being continued to establish a salt research laboratory at Sambhar and other research stations and model salt farms at Madras, Travancore and Orissa in accordance with the recommendations of the Salt Research Committee.

The Institute is the twelfth in the chain of national laboratories. The main function of the Institute will be to work out methods for improving the quality of salt and to increase the salt production for domestic as well as industrial uses. The sources of salt, such as sea and lake brines, contain besides salt, other important chemicals. It will be the object of this Institute to conduct research on the chemical recovery of the by-products as such or to utilize them for the manufacture of other industrially useful chemicals. The work of the Institute will be carried out in three divisions: (1) Division of Inorganic Chemistry; (2) Division of Physical Chemistry; and (3) Division of Chemical Engineering. The Institute will also have a library and research information service, a museum and a workshop. A salt farm will be established under the technical guidance of the Institute.

# REVIEWS

**Television Receiver Design.** (*Monograph 2: Flywheel Synchronization of Saw-Tooth Generators, Book VIII b of the Series of Books on Electron Valves*). By P. A. Neeteson. [Philips Technical Library; Distributors in India : Phillips Electrical Co. (India), Calcutta 20], 1953. Pp. 156. Price 21 *sh.*

Vol. VIII of this popular series deals with television receiver design. There is a larger work on "Television" by Kerkhof and Werner in Philips Technical Library to which the reader is referred, when looking for basic information. Book VIII is therefore intended for specialists in the field, and its subdivision into single monographs emphasises this tendency still further. The design of TV receivers deviates in many aspects from the conventional broadcasting receiver design. These monographs deal primarily with such absolutely new design problems. The first monograph discussed the wide-band IF amplifier technique. About three-quarters of the present one is devoted to one particular horizontal synchronisation circuit which has gained enormous popularity amongst receiver designers. Up to now it was an elaborate job to collect all the required information about this circuit from many journals and only skilled designers could fight their way through the diverging views and notations of a dozen different authors writing in different languages.

This little volume fills therefore a gap in the TV literature and its publication has been anxiously awaited by the specialists. Their high expectations have been fully met. We find in the first quarter a concise introduction to saw-tooth generators and their synchronisation. The fundamental idea of charging a storage element in a short interval over a gated tube and leaving it discharging with a constant rate over a longer interval leads automatically to 2 basic systems: capacitive or inductive saw-tooth generators. The latter type confronted the designers with new problems which could only be solved by the introduction of new "electronic valves developed for saw-tooth generators". Full data of ECL 80, EY 51, PL 80, PL 82, PY 80, PY 81 are therefore included.

"Flywheel synchronisation," the main subject of the book, greatly reduces the effects of noise and man-made interference on the quality of the received picture. It is largely applied in modern TV receivers, except in the cheapest types. It is unavoidable for receivers located in fringe areas.

The full theory of the circuit is presented and all possible variations of the basic circuit are indicated in clear diagrams. The many charts in the book will aid the designer in predicting the performance of the circuit in any specific application.

The specialists will hope that more monographs of this type will follow and that they may cover equally difficult problems like Flyback-EHT supply or AGC-control circuits in TV.

R. FILIPOWSKY.

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**Radio Receiver Design, Part I.** (Second Edition, Revised). By K. R. Struley. (Chapman & Hall, London), 1953. Pp. 667. Price 56 *sh.* net.

The first edition of this volume on the specialised branch of Radio Engineering, covering radio frequency amplification and detection, appeared exactly ten years ago when the undersigned had the pleasure of reviewing it in these columns of *Current Science*, in 1943. Its usefulness and popularity will be evident from the fact that, in between the two editions, the book went through five impressions justifying the hopes expressed at its first appearance. This is due perhaps to the science of electronics and radio having made phenomenal strides during the period, and certainly due to the dearth of books dealing, exhaustively and authoritatively, with the subject of radio receiver design.

The extent of revision and additions in the present volume is reflected in the number of pages showing an overall increase by 50 per cent. over the first edition. Problems of 'noise', wherever they occur—in valves, aerials or at aerial sites, etc.—form a very important and major addition to the text. Chapter I, dealing with fundamentals of transmission and reception, includes a section on signal-to-noise ratio and noise factor while Chapter II, on valves, contains treatment of valve noise, its calcula-

and measurement, in addition to the usual
...ssions on valve perameters, vector dia-
...s, and equivalent circuits, etc. New mate-
...in Chapter III, on aerials and aerial
...ling circuits, consists of treatment of wave-
..., balance-to-unbalance aerial feeder con-
...on for interference reduction. Additional
...mation on self-capacitance and mutual
...ctance of coils is given in Chapter IV on
...amplification besides rewriting the section
...IF noise. Little alteration has been made
...hapter V, on 'frequency changing', which
...ribes superheterodyne and synchrodyne
...ciples and the properties required of a
...iency changing valve, including noise
...ng in such circuits. In Chapter VI, on
...lators for superheterodyne reception,
...ciples of all types of oscillators, their fre-
...cy variations, etc., are covered, special
...res being the section on ganging of oscil-
... and signal circuits including effects of
...ponent tolerances on frequency. Chapter VII
...ntermediate frequency amplification covers,
...ddition to the rearrangement of old mate-
...on coupled circuits, variable selectivity,
...n of IF transformers, etc., exhaustive
...ment of crystal coupled IF transformers.
...last chapter on detection has undergone
...minor changes. Four new appendices have
...added on "Network equivalents".

...he order of treatment, which is reverse of
...usually found in books on radio engineer-
...has been retained in this edition, presum-
...due to the success of the first edition. The
...ation imposed by the choice of subject-
...er may be responsible for this, as was re-
...xed while reviewing the earlier edition, for
...a point to consider whether one designs
...dio receiver from its terminal end or at
...aerial end! However it can be stated un-
...atingly that the author has succeeded in
...ging out the essentials of design of various
...s of radio receivers—AM, FM, VHF, etc.,
...g freely analytical methods at every stage
...evelopment and giving numerical examples.
...seful list of references to original papers
...ws each chapter.

...he reviewer warmly recommends the pre-
...volume to students and teachers alike in
...fascinating field of radio and electronics,
...will find it valuable for study and refer-
...e. Those engaged in receiver design will
...rly await the revised second edition of
...II of the book. The price of 56 *sh.*, which
...vice that of the first edition, is a little high.

N. B. Bhatt.

**Mechanical Vibration.** By G. W. Van Santen.
(Published by Philips' Technical Library,
Eindhoven.) [Distributors in India : Philips
Electrical Co. (India), Calcutta 20], 1953.
Pp. xvi + 296. Price not given.

An experimental approach to vibration prob-
lems involves the use of quite elaborate com-
mercial equipment, literature on which are
only available from company catalogues. The
author of this book is attached to the indus-
trial control and measuring apparatus depart-
ment of Philips Industries—a firm which has
vast experience in the building of equipment
used in the study of vibration phenomenon.
The author is consequently well qualified to
deal with vibration instrumentation. Three
chapters of the book (pp. 208-78) are in the
reviewer's opinion, an outstanding feature of this
book. In it are dealt the principles of equip-
ment for the measurement of vibration, instru-
ments for the measurement of vibration and
some practical hints on vibration measurement.
These three chapters will interest all readers
concerned with problems arising from vibra-
tion or whose work entails the measurement of
vibration.

In the remaining 200 pages of the book, the
author deals with linear vibration, non-linear
vibrations and relaxation oscillations. There
is no departure from the classical treatment
though the author has spiced it with numerous
examples and analogies to illustrate points from
theory.

There are a few errors, both typographical
and grammatical, in the book which the re-
viewer hopes will be removed in the next edi-
tion.

The reviewer commends this book to all
interested in vibration problems and feels that
the book justifies its appearance as it fills the
need for a book which clearly sets out the
rudiments of vibration instrumentation.

A. Ramachandran.

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**Recommendations for the Disposal of Carbon-
14 Wastes.** (National Bureau of Standards
Handbook 53). (Order from the Government
Printing Office, Washington 25, D.C.). Pp. 14.
Tables 2. Price 15 cents.

The recommendations contained in this
handbook were prepared by the National Com-
mittee on Radiation Protection, Sub-Committee
on Waste Disposal and Decontamination.

As the problem of the disposal of radio-
active wastes varies over such wide limits,
depending upon the usage to which the iso-

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topes are put, the NCRP decided that it was not feasible to incorporate in one volume broad recommendations covering all situations and materials. Accordingly, individual reports dealing with particular conditions will be issued from time to time. Handbooks 48, 49, 51, 52 and 56 dealing with problems of contamination, waste disposal and instrumentation have already been published.

The disposal recommendations are divided into six sections: Isotopic dilution, Sewers, Incineration, Atmospheric dilution, Garbage and Burial. In addition the handbook contains general considerations, bases for recommendations and references.

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**Industrial Inorganic Analysis.** By Roland S. Young. (Chapman & Hall), 1953. Pp. viii + 368. Price 36 *sh.* net.

The scope of applied analytical chemistry has become so wide that no one man can hope to be an expert in all its fields, and no text-book can cover all the ground. It is no exaggeration to say that the author of the book under review has made a supreme effort to include as much material as possible in a short book. Even though Mr. Young modestly claims that his book is mainly intended for the younger analytical chemists, it can definitely serve as a useful guide book in any analytical laboratory.

The author has made two general changes from the usual practice of writing books on analytical chemistry. He treats every element individually and according to their alphabetical order and not according to groups, and secondly only the most simple and the most suitable methods for the separation and determination of the various elements are dealt with, instead of compiling a number of methods and leaving the selection of a particular method to the reader. Even though the details of the various methods described are freely drawn from classical books on analytical chemistry, the selection of the particular method is original and their treatment is based purely on the personal experience of the author. However, there are a number of instances wherein some of the most obvious and simple methods are overlooked, as for instance in the determination of manganese. Volhard method, which is highly dependable and capable of wide application, is completely left out. For ferrous iron determination the procedure given is vague and is likely to give erroneous results. Further, no method is given for determining ferrous iron in insoluble materials like silicates. Excepting

for a few passing references, no serious attempt is made to describe any of the well known (instrumental) physical or physico-chemeical methods adopted for analytical work in modern inorganic industrial laboratories. Considering the fact that this volume was not intended to be a comprehensive treatise on inorganic analysis these shortcomings may be overlooked. However, this book is a valuable contribution to inorganic analytical chemistry and it will be found very useful to not only the undergraduates in chemistry but also to the practising analytical chemists.

N. Jayaraman.

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**Biology of the Cryptic Fauna of Forests, with Special Reference to the Indigenous Forests of South Africa.** By R. F. Lawrence. (Published by A. A. Balkema, Cape Town), 1953. Pp. 408. Price 50 *sh.*

As the author himself admits in the preface, he had some difficulty in choosing the title of this book which deals with the ecology of the fauna living hidden in the *forest floor.* In the words of the author (p. 7): "My object has been to give a general account of the animals which are to be found in the humus of the South African forests, their biology and background." The author's expressions 'cryptic fauna', 'cryptozoic fauna' and 'cryptozoa', therefore, do not adequately explain the scope and the limitations of the contents, since even the insect borers which live inside tree trunks are 'cryptozoa'.

The book opens with a chapter on the general characteristics and distribution of the forests of South Africa. This is followed by an interesting discussion on the faunistic composition of the forest floor and a comparison of that fauna with other biological communities. In the four subsequent chapters such aspects as form and colour, movement, respiration and the sensory organs are considered. Then follow the chapters on weapons, enemies and parasites, reproduction and development, postnatal growth, food and economics, and, finally, there is a discussion on distribution in space and time. At the end there is a list of selected bibliography, an author index and a general index.

The mode of treatment of each section is in the form of an essay and more than ordinary emphasis has been laid on morphology. Among the animal phyla and classes dealt with are: Protoza, Platyhelminthes, Nemathelminthes, Annulata, Mollusca, Arthropoda (including

Onycophora, Crustacea, Myriapoda, Arachnida and Insecta). Among the insecta references have been made to the Collembola, Thysanura, Hemiptera, Orthoptera and Coleoptera. The omission of the Isoptera (termites) is difficult to understand since termites form an important element in the forest floor and are rich both in species and in numbers. The Acari (mites) have also been dealt with all too briefly.

The illustrations are well drawn and the photographs are of excellent quality. The printing and get-up of the book leave little to be desired.

By and large this is a good and well presented compilation of the available knowledge of the fauna of the forest floor of South Africa and should be of interest to all students of animal ecology and, in general, of zoology.

M. L. ROONWAL.

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Poisonous Plants of India, Vol. I. (*Scientific Monograph No. 17, The Indian Council of Agricultural Research*). By R. N. Chopra, R. L. Badhwar and S. Ghosh. (Government of India Press, Calcutta), 1949. Pp. liv + 762. Price Rs. 30.

Little is known about the physiological significance of the occurrence of complex organic compounds—such as glucosides, resins, toxalbumins, fixed and essential oils, bitter principles, alkaloids and steroids—elaborated following the basic, photosynthesised sugars in tissues of green plants. Many of them, doubtless poisonous, have been recognised by man as useful specifics in the alleviation of human suffering. Knowledge of plants with medicinal properties, plant narcotics and abortifacients dates back to very early times in the history of India, though useful references are meagre and scattered. The monograph on "Poisonous Plants of India" offers a fine compilation of descriptive and distributional accounts of indigenous poisonous plants in general, pharmacognostical informations, details of the chemistry and physiological activities of the active principles and mode of treatment wherever experimental evidence is obtainable.

The Introduction is a comprehensive chapter giving concise accounts of meteorological conditions, topography and zonal vegetations of this country, historical review, explanatory account of the toxic constituents of plants, action of poisons, symptoms, diagnosis and prognosis of poisoning, treatment and prevention, supplementary lists of insecticidal plants and those poisonous to fish and lastly synopsis of natural orders, following Bentham and Hooker's System of Classification of Higher Plants. 192 species of poisonous plants belonging to families Ranunculaceæ to Convolvulaceæ are dealt with in detail in this volume.

This well-written monograph is welcome as a useful standard reference work for botanists, chemists and pharmacologists engaged in the search for newer plant remedies. The possibilities of establishing several more efficacious drugs from plant products are undoubtedly enormous and promising and can never be overemphasised in view of the fact that the list of drug plants having an established reputation in modern medicine form only a fraction of the vast number of plants, the potentialities of which demand thoughtful, extensive and intensive experimentation. This book would also be educative to a good majority of the lay people in this land. People of other countries will find it informative and useful because of the close link in the representation of plant genera and species in India with both the Eastern and Western land formations. I will be failing in my duty if I do not congratulate our veteran 'alkaloid-hunter' Dr. Sir Ram Nath Chopra and I, therefore, do so with genuine pleasure. T. S. SADASIVAN.

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## Books Received

*On the Congruence of Sets and Their Equivalence by Finite Decomposition.* By W. Sierpinsky. (Lucknow University Studies No. XX, Faculty of Science Session, 1948-49), 1954. Pp. 117.

*The Collected Papers of Peter.* By J. W. Debye. (Interscience Publishers, Inc.), 1954. Pp. xxi + 700. Price $ 9.50.

*A Compilation of Papers on the Assam Earthquake of August* 15, 1950. By M. B. Ramachandra Rao. (Central Board of Geophysics), 1953. Pp. vii + 112.

*Geometrical Mechanics and De Broglie Waves.* By J. L. Synge. (Cambridge University Press), 1954. Pp. vi + 167. Price 25 *sh.*

*A New Periodic Table of the Elements Based on the Structure of the Atom.* By S. I. Tomkeieff. (Chapman & Hall), 1954. Pp. 30. Price 10 *sh.*

*The Physics of Experimental Method.* By H. J. J. Braddick. (Chapman & Hall), 1954. Pp. xx + 404. Price 35 *sh.*

*Optical Workshop Principles.* Second Edition. By Charles Deve. English translation by T. L. Tippell. (Hilger & Watts, Ltd., London). Pp. xxiv + 436. Price 42 *sh.*

# SCIENCE NOTES AND NEWS

## Occurrence of Hepaticeae in Bihar

J. G. Srivastava, A. S. Yadav, A. S. Mehta and D. V. Saxena of the Department of Botany, Patna University, write as follows:

Ten species of Liverworts belonging to nine genera have been recorded from the Parasnath Hills in Bihar. They are *Dumortiera hirsuta* (3,500'), *Targionia hypophylla* (4,000') *Cyathodium tuberosum* (4,000'), *Plagiochasma articulatum* (4,500'), *P. appendiculatum* (4,500'), *Marchantia polymorpha* (4,500'), *Riccia himalayensis* (900'), *Fimbriaria nepalensis* (4,500'), *Anthoceros himalayensis* (4,500'), *Notothylas indica* (4,500'). In addition, *Riccia fluitans* and *Ricciocarpus natans* were collected from Topchanchi lake (800'). Also *Riccia sanguinia* and *R. pathankotensis* were collected on the plains (170') at Patna, the former on the lands left by Ganges and the latter in the Botanical Gardens of the Science College, Patna.

## Achromatic Combination of Two Lenses

Shri Mahendra Singh Sodha and A. N. Nigam, Allahabad University, write as follows:

The error in the earlier note by the authors (*Curr. Sci.*, 1953, 22, 232) pointed out by Murthy (*Curr. Sci.*, 1953, 22, 369), is purely due to the use of a sign convention different from the customary one. Further, it is impossible to obtain complete achromatism with two lenses of the same material. Murthy obtained such an erroneous result because he assumed the sum of two equations to be true, while they have to be individually satisfied.

## Element 100

The century of chemical elements has been completed by the making of Element No. 100 by workers in Professor G. T. Seaborg's Department in the University of California.

Whereas element 99 was first made by bombarding uranium with the nuclei of nitrogen atoms accelerated to high energies in a laboratory machine, element 100 has been made from plutonium by heavy exposure to neutrons in a nuclear reactor. The reactor used was the Atomic Energy Commission's "materials testing reactor" at Arco, Idaho, and the experiments were done by B. G. Harvey, S. G. Thompson, A. Ghiorso and G. R. Choppin, Professor Seaborg's associates.

Irradiation was in two stages. In the first, plutonium (element 94) was converted into californium (element 98) and this was separated chemically from both the plutonium and the other products. The californium was then again irradiated and elements 99 and 100 obtained from it. Element 100 is the first new chemical element to be made in this way. Although the quantity of it available was very small, its chemical identification is considered definite.

Just as element 99 showed analogies with the rare earth element holmium (element 67), so element 100 shows analogies with the succeeding rare earth element, erbium (element 68). In the form in which it has been prepared, it has a half-life of about 3 hours and an atomic weight of 253, the highest yet reported. The element is said to have no application either in atomic weapons or the development of atomic energy.

## European Council for Nuclear Research

The European Council for Nuclear Research has decided to offer the Directorship to Professor Felix Bloch, Nobel Laureate in Physics, who is now attached to Stanford University, U.S.A.

As Professor Bloch would not commit himself for longer than 2 years, the Council has elected Professor Eduardo Amaldi, of the University of Rome, as Deputy Director, and Professor C. J. Bakker, of the University of Amsterdam, as representative of the scientific group leaders.

## X-Ray Camera to Study Materials at 4,000° F.

An X-ray camera capable of studying materials at temperatures up to 4,000° F. has been developed at the Oak Ridge National Laboratory, U.S.A. The camera is being used in ceramics research work by staff members of the Metallurgy Division of ORNL. Designed by J. R. Johnson, a technical adviser, the camera has been used successfully to produce diffraction patterns in studies of hafnium oxide, as well as a number of other oxides and metals.

To photograph the diffraction pattern of the material under study, X-rays produced in a standard X-ray tube pass through a tube guide mounted on the film holder, then through a small disk of beryllium and a collimator. The X-rays strike a rotating sample and are diffracted through a beryllium "window" and the pattern image is registered on photographic film.

### Electrochemical Processes and Their Applications to Indian Industry

A symposium on "Electrochemical Processes and Their Applications to Indian Industry" was held in the Central Electro-Chemical Research Institute, Karaikudi, on the 27th and 28th March 1954. Research workers from various laboratories, and representatives of industry and of Government Departments numbering nearly 40 attended the proceedings. Sir S. V. Ramamurthi, who inaugurated the symposium, pointed out the vital rôle that the electrochemical industries play in a modern economy and looked forward to an industrial revolution in this country based on wood and electricity instead of that based on iron and coal as in Europe.

51 papers were presented at the symposium covering the following subjects: Electro-metallurgy and electrothermal processes; Electrolytic processes, inorganic and organic; Batteries, electrodeposition and electropolishing; Miscellaneous, including papers on electric discharges and electroanalysis.

### ATIRA

The Ahmedabad Textile Industry's Research Association which was recently declared open by the Prime Minister, Pandit Jawaharlal Nehru, is an institution organised on a co-operative basis, the membership being thrown open to all the textile units in the country. One of the outstanding features of the ATIRA is the strong and valuable support it has been receiving from industry as well as the Government, from labour as well as from technicians. The scope of its activities is not restricted to the fields of technology and physical sciences, but includes social sciences also.

### Directory for Arid Zone Research

UNESCO has just published a "Directory of Institutions Engaged in Arid Zone Research" which gives detailed information about institutions engaged in scientific and technical research on problems of arid and semi-arid areas. It is a 110-page volume in the series devoted to the Organization's activities on behalf of developing and increasing the contributions of arid zone research to the improvement of the living standards.

The Directory contains 5 chapters, each dealing with a Continent, listing the countries and institutions in alphabetical order. In addition to the title, address and location of each research institution, other particulars given include its history, aim, nature, structure, programme and equipment. The price of the publication is $ 1.50.

### Composite Wood

A Journal with the above title has been started to promote the study and practice of the science and technology of composite wood—adhesives, plywood, laminated and other improved woods, building boards, etc.—and allied subjects.

The opening number contains four articles: Steaming and Boiling of Logs for Veneer Production, by F. Kollmann; A Small Infra-red Dryer, by D. Narayanamurti and B. N. Prasad; Prolamin Film Adhesive, by D. Narayanamurti and H. C. Pandey; Utilization of Tapioca Steams and Hoop Pine Bark, by D. Narayanamurti and Jastinder Singh. The section on Abstracts is bound to be highly useful to students and research workers in the field. Further particulars can be had from the Editor (Dr. D. Narayanamurti), 15, Beeson Road, Forest Research Institute, New Forest P.O., Dehra Dun, U.P.

### Research Studentship in Geophysics at Cambridge

The Royal Dutch Shell group of oil companies is offering a research studentship in geophysics of value £ 450 a year (£ 500 for married men) and tenable for 2-3 years at the University of Cambridge, which is open to men of any nationality less than 27 years old. Further information can be obtained from Mr. B. C. Browne, Department of Geodesy and Geophysics, Downing Place, Cambridge, to whom application must be made by July 1.

### Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Botany to Shri C. Venkata Rao for his thesis entitled "Floral Morphology and Embryology of Malvales".

The University of Mysore has awarded the D.Sc. Degree in Chemistry to Shri A. R. Vasudeva Murthy for his thesis entitled "Studies in the Chemical Behaviour of Some Compounds of Sulphur".

The University of Saugar has awarded the Ph.D. Degree in Chemistry to Shri G. S. Rao for his thesis entitled "Iso-polyacids and Their Salts".

The Osmania University has awarded the Ph.D. Degree in Physics to the following: P. G. Puranik—"Studies in Raman Effect: Influence of Environment on Group Frequencies"; K. S. Iyengar—"Photo-Elastic Properties of Solids as Studied by Ultrasonic Methods"; K. V. Krishna Rao—"Photoelastic Effect in Crystals".

## OPTICS OF THE PEARL

THE pearl stands in a class by itself as a gem-stone which does not need the services of a lapidary to enhance its natural beauty. The characteristic of the pearl most admired is its lustre, though other features such as shape, size and colour are also important. A precise understanding of the optics behind its loveliness is therefore a matter of more than ordinary interest. The inadequacy of the explanations of it given in the text-books on gemmology becomes apparent on a critical examination.

Natural pearls are very expensive, and this is sufficient to discourage anyone who might feel inclined to investigate their structure and optical behaviour. Fortunately, however, the cultured pearls produced by the Japanese industry offer to the student a wealth of material of excellent quality at a modest price. As is well known, their production is the result of an operation by which a spherical pellet of calcareous substance is introduced into the body of the pearl oyster. In the course of years, the

mollusc deposits a great many layers of pearly substance around the nucleus thus provided. Since the latter is a polished sphere, the deposited layers are also very regular and smooth. Indeed, it is the case that cultured pearls are optically superior to the more expensive natural pearls. By cutting a cultured pearl into halves, the nucleus can be taken out and the hemispherical shells of pearly material thus detached are in a very suitable form for physical examination. Many interesting observations can be made with them as has been described in a recent paper[1] by the present authors.

Very simple methods of observation suffice to reveal some highly significant facts regarding the optical behaviour of pearls. A small aperture backed by a brilliant source of light is placed a few feet above the head of the observer and the pearl is held in the path of the strong beam of light thus provided. It is then viewed by the observer through a hand magnifier. The optical effects then observed fall roughly into three groups, *viz.*, (*a*) the

reflection-diffraction spectra consisting of focus-sed images of the light source, (b) a chromatic diffusion halo surrounding these images and extending over the surface of the pearl over a considerable area, and (c) a general diffusion visible right up to the periphery of the pearl. We shall proceed to describe each of these phenomena in detail and discuss their origin and significance.

If, as is the case with perfect pearls, the layers of nacreous material are parallel to the external surface, they would conspire to give a single reflected image of the source exhibiting colour as a result of interference between the effects of the successive layers. If, on the other hand, the layers meet the surface obliquely, the latter would present the aspect of an eche-lon grating. It has been shown by us[2] that in the case of mother-of-pearl the light dif-fracted at the surface as also that reflected by the internal stratifications appear together as a set of diffraction spectra forming a regular sequence. In the present case as well, similar results are noticed when the illuminated pearl is viewed in focus through a magnifier. The separation of the successive orders of spectra is usually very small, but occasionally they can be seen distinctly separated. Fig. 1 is a
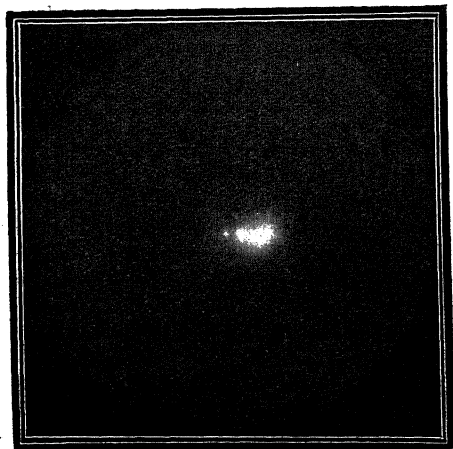


FIG. 1

photograph obtained with a natural pearl in a particular setting. Three spots in a line can be seen; the sharpest appearing at the centre is the spectrum of zero order; the second is the diffraction spectrum of the first order, while the third spot is the characteristic iridescence appearing as the spectrum of the second order.

We now proceed to consider the second of the effects mentioned above, *viz.*, the chromatic diffusion halo. This phenomenon which does

not appear to have been noticed earlier has been briefly described by us.[1] It is character-istic of pearls and plays a fundamental role in their optical behaviour. Its observable features are notably influenced by the shape of the pearl, by the inclinations of the stratifications to the external surface and by the degree of optical perfection of the latter. The chromatic halo takes its simplest form in the ideal case of a spherical pearl in which the stratifications are strictly parallel to the external surface. It then appears as a diffuse circle of light with fainter outlying regions surrounding the irides-cent reflection; there is a concentration of in-tensity in the halo near the opposite ends of one diameter. The predominant colour of the halo is complementary to the colour of the iridescence. A photograph of the halo in this typical case is reproduced as Fig. 2. A slight



FIG. 2

asymmetry of the intensity on the two sides is usually noticed, and this is very prominent when the successive orders of the reflection-diffraction spectra are widely separated. The colour of the diffusion halo may then be quite different on the two sides of it.

The observed effects indicate that the diffu-sion halo has its origin in the internal stratifi-cations of the pearl and not at its external surface; this is indeed clear from the fact that its colour is complementary to that of the iri-descence. The origin of the halo is to be sought for in the fact that the material of the pearl consists of individual crystallites of aragonite imbedded in a network of conchyolin. Each crystallite would diffract the light waves inci-dent upon it in various directions, the irides-cence appearing in the direction in which the diffracted radiations from the crystallites in any given layer are in agreement of phase. In other directions, they would give rise to a cone of diffuse light.

Fig. 3 illustrates a remarkable effect exhibited by pearls. It is a photograph of a natural pearl illuminated centrally over a very narrow region on the side *opposite* to that from which it was observed and photographed. It will be noticed that the entire pearl is thereby ren-
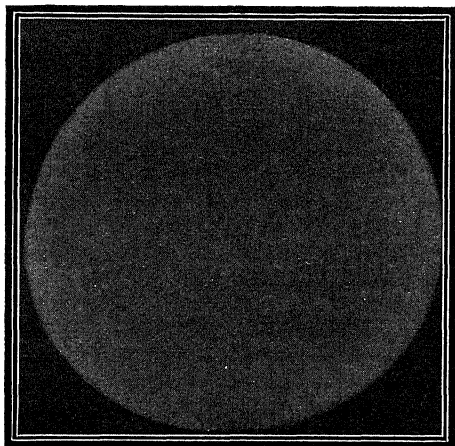


FIG. 3

dered visible, the periphery appearing brighter than the central region. It is evident that the light falling normally on the rear surface of the pearl has travelled around following the laminations of its structure, and not *through* the pearl. A similar effect is observed in all cases, irrespective of the direction in which the illuminating pencil falls on the pearl or the particular area on which the incident light falls.

We shall now turn to the role which the three effects described above respectively play in the optical behaviour of pearls. Fig. 4 (a), (b) and

pearl, and (c) a polished spherical segment of mother-of-pearl removed from a cultured pearl. All the three objects were illuminated and viewed in the same fashion, *viz.*, normal to their respective surfaces, the original source of light being of small angular dimensions. But the appearance of the three objects is totally different. In the case of the steel sphere, we see a well-defined optical image of the original source, but the sphere remains invisible except in the immediate neighbourhood of the image of the source where a faint illumination is visible due to the imperfect polish of the surface. In the case of the mother-of-pearl as well, the optical image of the source is a prominent feature, but is much feebler than in the case of the steel sphere. On the other hand, the mother-of-pearl is itself visible by reason of the light diffused in the material.

Writers on gemmology usually attribute the beauty of the pearl to two distinct effects, *viz.*, the reflection of light from the interior of the pearl and the diffraction of light at its exterior surface. The latter effect would be non-existent in the case of a perfect pearl. Moreover, the angular separation of the various orders of the reflection-diffraction spectrum is so small, that with an extended source of light they need not at all be considered as distinct phenomena. Further, the reflection of light at a spherical surface would not suffice to make it visible, much less to make it an attractive object. It is evident therefore we have to look elsewhere for an explanation of the beauty of the pearl. This is to be found in the superposition of the reflected light and the chromatic diffusion halo. Such superposition would necessarily occur when the source of light is of extended area,
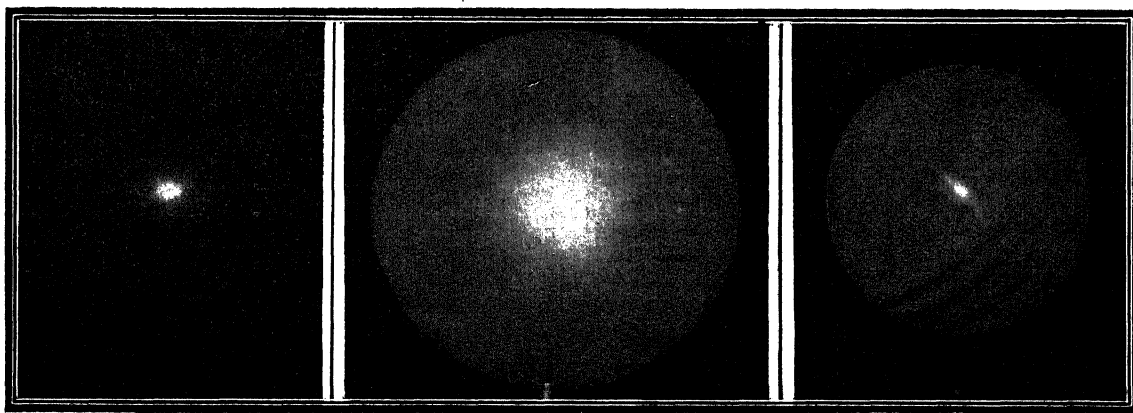


FIG. 4       *a*                                    *b*                                    *c*

(c) reproduce photographs showing respectively (a) a polished steel sphere, (b) a cultured

and since their colours are complementary, their joint effect would be to make the pearl

seem to the observer to be a silvery white and lustrous object, quite unlike a polished sphere which only exhibits the reflected images of external objects. The impression that the pearl is a lustrous object would be further enhanced by the diffuse light emerging from the shadowed areas on which no light is directly incident. The brilliance of the periphery would further enhance the general effect by enabling the entire pearl to be clearly seen.

We may sum up the situation by the statement that the coloured reflection of light by the stratifications of the nacre is not by itself an adequate explanation of the beauty of the pearl; the special properties of the material which manifest themselves in the chromatic diffusion halo and in the propagation of light parallel to the stratifications play the leading role in making the pearl appear a lustrous and attractive object.

C. V. RAMAN.
D. KRISHNAMURTI.

1. Raman, C. V. and Krishnamurti, D., *Proc. Ind. Acad. Sci.*, 1954, **39A**, 215.
2. —, *Ibid.*, 1954, **39A**, 1.

## RADIO-THULIUM TO REPLACE X-RAYS

DEVELOPMENT of a portable X-ray unit using radioactive thulium in place of electricity was announced recently by the Argonne National Laboratory of the United States Atomic Energy Commission. Weighing less than 10 lb., the unit produces rays comparable to a 100,000-volt X-ray machine without the need of a power source. Its light weight makes it possible for a doctor to carry it to isolated areas where electricity is not available and to take X-rays of persons who cannot be moved.

The active component of the instrument is a tiny particle of thulium which has been made radioactive in the heavy water nuclear reactor at Argonne. Thulium is an extremely rare material which heretofore has found little practical application.

The instrument does not require an electrical power supply as does conventional X-ray equipment. In addition, it is quite inexpensive. Exclusive of irradiation charges, the total cost of the first model was $40. The use of thulium as an X-ray source was first suggested by British scientists who have developed a similar but less powerful instrument. Excellent rare earth separation facilities and powerful reactors in the U.S.A. permitted development of the Argonne instrument, which contains a thulium source several hundred times more powerful than the British units. Industrially also, it has potential use as a density determination device. It may find considerable use in the determination of levels and densities of liquids in closed systems.

## REORGANISATION SCHEME OF THE BOTANICAL SURVEY OF INDIA

THE main features of the reorganisation scheme are as follows: (1) The division of India into a number of regional circles based on phyto-geographic affinities, each under a Regional Botanist with his headquarters at Dehra Dun or Lucknow, Madras, Calcutta and Poona respectively; (2) Establishment of a Central Directorate under the Chief Botanist, for co-ordinating the activities of the various Regional Circles; (3) The creation of a Central Botanical Laboratory under a Director at a suitable place in India, where the living plant will be studied in relation to its botany and its utility to the nation; (4) The maintenance of a Central National Herbarium which will house the "type specimens" and a fully representative collection of the plants comprising the Flora of India; and (5) Maintenance of a Botanical Museum on modern lines at Calcutta.

Collaboration with Universities and Research Institutions will be encouraged by the granting of stipends to staff and research students to conduct research on problems dealing with the Flora of India, and for collecting material for the long overdue revision of Hooker's "Flora of India".

# SOLENOPORACEÆ FROM THE CRETACEOUS ROCKS OF SOUTH INDIA

L. RAMA RAO AND S. SAMBE GOWDA

THE occurrence of Solenoporaceæ in the Cretaceous rocks of South India was first recorded in 1936 in the Memoir on the fossil algæ from the Niniyur group (Danian) of the Trichinopoly Cretaceous area.[1] The algal flora in these beds is mainly composed of the Dasycladaceæ and the Corallinaceæ; but along with these, there is also the solitary occurrence of the genus *Parachœtetes* belonging to the Solenoporaceæ. This form has been described and its affinities discussed in the memoir, and it is shown that it represents a new species, named *P. asvapatii*. Some years later, S. R. N. Rao[2] found the remains of Solenoporaceæ in the Cullygoody limestone, a formation also belonging to the Cretaceous series, but older than the Niniyur beds. He recognised in this limestone two species of Solenopora—*S. jurassica* and *S. coromandelensis*—and on the basis of these fossils, especially the former, he put forward the view that the Cullygoody limestone must be considered as Jurassic in age, and not Cretaceous as is now generally believed.

standing interest and significance. Both of them relate to the presence of Solenoporaceæ; and the following is a brief account of these two occurrences.

1. *No. A3/13.* (from the cherts belonging to the Niniyur group—Danian).

The general form of this alga is shown in Fig. 1. The thallus is broad and fan-like; the cell rows showing a typical 'fountain'-like arrangement are well seen in Fig. 2. The longitudinal cell walls are prominent, but of variable thickness ($4$-$12\,\mu$); they are wavy and sinuous with the result that the width of the cells becomes variable ($32$-$55\,\mu$) even along a single row. The transverse partitions are irregularly placed without any 'alignment' so that the lengths of the cells also vary from place to place ($27$-$175\,\mu$); these are concave towards the periphery, and the cell rows show a 'jointed' appearance in the region of these partitions. An interesting feature (seen under high magnification) is that the cell walls and the transverse partitions are both distinctly
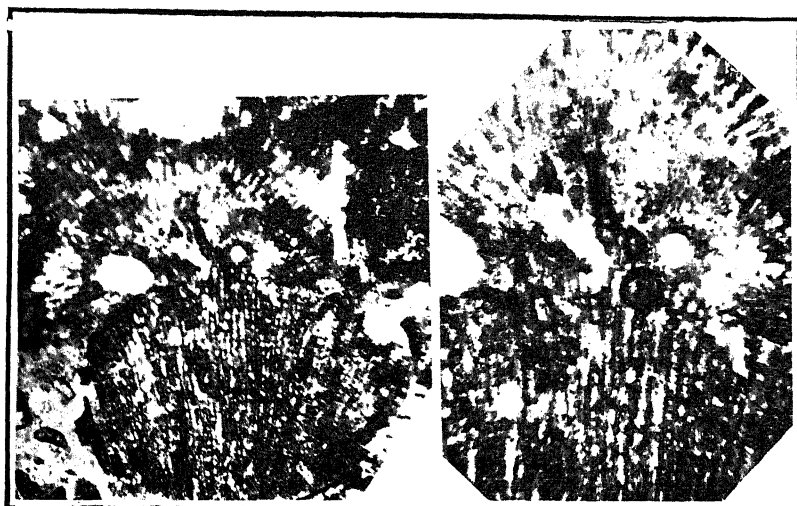


FIG. 1. ×24



FIG. 2. ×40

We have now taken up the study of the fossil algæ in the entire Trichinopoly Cretaceous succession* and in the course of this work we have noticed the presence of numerous algæ, including the Solenoporaceæ. While it will take some time before a full description of this algal flora is ready for publication, there are two occurrences noticed in this area which call for immediate announcement in view of their out-

double-layered. There are no pores in the cell walls; and there is no differentiation of the tissue into a hypothallium and perithallium.

2. *No.* E.72 (from the coral reef limestone near Cullapaudy, belonging to the Utatur group—Cenomanian).

been remarked by Pia, "the division of this family into different genera, and the systematic position of the whole group are still matters of controversy". The only three valid stems now recognised in this family are *Solenopora, Parachætetes* and *Petrophyton.* From a study
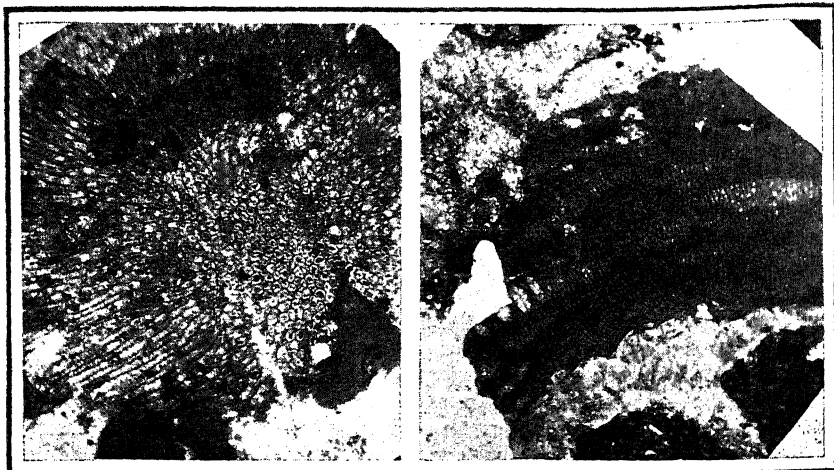


FIG. 3. ×40                   FIG. 4. ×40

The photo (Fig. 3) gives a good idea of this form; the section is longitudinal for part of the thallus and transverse for the other part, so that we get both the views of the form side by side. The thallus shows a number of cell rows which are generally straight, and subparallel; they show a tendency to diverge, but not quite 'fountain'-like. The longitudinal walls are somewhat sinuous and wavy; the width of the cells becomes therefore variable from place to place, the actual variation being from 23-32 $\mu$. The transverse partitions are irregularly placed so that the lengths of the cells are also highly variable (50-180 $\mu$); these partitions are concave towards the periphery. There are no pores in the cell walls, either longitudinal or transverse. There is a feeble tendency for a dichotomous branching of some of the cell rows towards the periphery, but the branches are still 'apposed' and not diverging. The transverse section shows the polygonal to sub-circular outlines of the cells; but the cell cavity (lumen) is circular. Some of the cell outlines enclose a 'double-lumen' in contact, due to the branched cell row. There is no indication of the differentiation of the tissue into hypothallium and perithallium.

Important contributions to our knowledge of the family Solenoporaceæ have been recently made by Garwood, Pia, Yabe, Pfender, Peterhans, Harlan Johnson and others; but as has

of the two forms described above with special reference to cell measurements, disposition of the transverse partitions, and the nature of the tissue it is clear that they do not belong either to *Parachætetes* or *Petrophyton;* they evidently belong to the genus *Solenopora.* Both our forms have been compared in detail with the two species of *Solenopora* (*S. jurassica* and *S. coromandelensis*) already described by S. R. N. Rao from the Cullygoody limestone. While both the present forms resemble *S. jurassica* in the large variation of the cell lengths, they are quite different in this respect from *S. coromandelensis;* when next we take into consideration the other characters including the widths of the cells and their proportion to the thickness of the cell walls, it is seen that the two forms now under study are both different from the species *jurassica* and *coromandelensis.* The present forms are therefore recognised as constituting two new species; it is proposed to call the former (seen in No. A3/13, Fig. 1) *Solenopora tiruchiensis* (after the District where the Cretaceous rocks of South India are typically developed), and the latter (seen in No. E 72, Fig. 3) as *Solenopora sahnii* (after the late Prof. Birbal Sahni, the distinguished Indian palæobotanist).

The most remarkable feature of the occurrence of these Solenoporaceæ here is the fact that the very rock section (E 72) which con-

tains *S. sahnii* also contains a fine section of the Corallinaceæ (Melobesieæ) belonging to the genus *Archæolithothamnium* (*vide* Fig. 4). The section shows clearly the nature and arrangement of the cells both in the hypothallium and perithallium; the erect ovoid sporangia (height about twice the breadth) are also well seen. From the cell measurements and other characters, this form appears to be identical with (or closely allied to) *A. lugeoni* described from the Niniyur beds in the 1936 Memoir.

This occurrence of a *Solenopora* and an *Archæolithothamnium* in the same rock of undoubted Cretaceous age is of the greatest interest. Our present studies of the fossil algæ in the Trichinopoly Cretaceous area show that the coral reef limestones (Cenomanian) which show the Solenoporaceæ also contain plenty of Coralline algæ; the Niniyur beds (Danian) which contain abundant Coralline algæ also show the Solenoporaceæ. These occurrences of the Solenoporaceæ and the Corallinaceæ together, (and both of them truly *in situ* in nature) in the same rocks of undoubted Cretaceous age are evidently of special significance since they show that the current view that the Coralline algæ made their appearance (in the Cretaceous) only after the Solenoporaceæ became extinct (in the Jurassic) is no longer tenable. Further investigations of these algal floras in the Trichinopoly Cretaceous, now under progress, will no doubt confirm this position and provide the most valuable material for the study of the mutual chronological and evolutionary inter-relationships of these two important families of fossil algæ.

1. Rama Rao, L. and Julius Pia, *Mem. Geo. Sur. Ind Pal. Ind.*, 1936, **21**, 4.
2. Rao, S. R. N., *Jour. Ind. Bot. Soc.*, M. O. P. Iyengar Commemoration Volume, 1946.

## SCIENCE IN ANCIENT INDIA

ACCORDING to an article by M. Jean Filliozat, Professor of the College of France, published in the *Journal of World History*, research in ancient India led very early to the development of theories which, although ahead of their time, were nevertheless logical systems of thought about the structure of reality, that is to say, of science. He deals chiefly with astronomy and physiology discussed in the oldest Indian texts between 1500 and 500 B.C.

The most important astronomical work revealed in the Vedic texts is the list of 27 or 28 constellations marking the path of the moon. This sort of lunar zodiac evidently contributed to Brahmin religious rites, which were based upon the position of stars; it permitted simultaneous determination of the position of the full moon and the sun in relation to the stars. Such astronomical knowledge was widely diffused in other countries. Later, when India became acquainted with Grecian astronomy, through cultural and commercial exchanges with the Roman Empire, these earlier methods were combined with the new ones dividing the zodiac into 12 "houses", the most widely used mechanism for astrological divination.

Two other discoveries in the field of astronomy were noteworthy, that of the trigonometric sine and of the "cosmic cycle". The former of these is described in a treatise dating from the middle of the 4th century B.C. The Arabic astronomer, al Battani, who introduced it to the West, gave full credit to its Indian origin. This was the basis for the development of trigonometry.

Calculation of the cosmic cycles of the universe were related to speculations in Greece and Western Asia about the "Great Year"—the period required for the stars to return to exactly the same apparent position which they occupied at the beginning of the interval. There is a close resemblance between the Grecian and Babylonian computations and those made in India much earlier.

In the fields of physiology and medicine, conceptions current in India between 1500 and 1000 B.C. are encountered later in Hellenic and Mesopotamian records. Some of these had an important place in the medical theories of Hippocrates.

Considering that it was India which first adopted the system of numbers, probably of Mesopotamian origin, which is the basis for our arithmetic, and spread it throughout the world, one is disposed to agree with Professor Filliozat that ancient India was indeed an energetic and influential source of scientific thought. It seems also reasonable enough to claim that she spread it throughout a region far greater than that reached by Greek science, which she generously welcomed and also diffused, along with her own teaching.—UNESCO.

# AMPHIBOLES ASSOCIATED WITH THE MANGANESE-BEARING ROCKS OF MADHYA PRADESH

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AMPHIBOLES associated with the Gondite series (Archæan Manganese-Silicate rocks) of India were first reported and described by Dr. Fermor[1] from Kajlidongri in Jhabua District of Central India and from the Balaghat, Bhandara, Chhindwara and Nagpur Districts in M.P. He remarks that these amphiboles occur very sparingly in the rocks except at Kajlidongri and divides them into two groups (*a*) yellow and greenish grey amphiboles referred to Dannemorite (?), and (*b*) the blue lilac-lavender amphiboles called Winchite and Juddite. The Dannemorite type of amphiboles and Juddite were reported mostly from M.P. while the only locality for Winchite was Kajlidongri in C.I. With the exception of Winchite the other amphiboles were not completely investigated.

In the course of a thorough re-examination and re-investigation of the non-opaque manganiferous minerals associated with the rocks of the Sausar series of M.P. undertaken by the authors it was found that amphiboles similar to Winchite were present in the rocks associated with the manganese ore deposits in the Ponia area of Balaghat District, M.P. This discovery of Winchite in the rocks of Madhya Pradesh is of considerable interest as hitherto this amphibole was reported only from the Kajlidongri area of Central India. Of greater interest, however, is the association with the Winchite of two other amphiboles obviously related to it but differing in their physical and optical characters. Big idiomorphic crystals of the manganese pyroxene Blanfordite, are also found associated with these amphiboles. A thorough physical, optical and chemical investigation of these amphiboles has been undertaken and this note records certain interesting preliminary observations.

## OCCURRENCE

The Winchite and the two other associated amphiboles occur in a pegmatite vein which has the same general strike as the country rocks—which are quartz schists with lenticles of manganese ore. These amphiboles occur as disseminated acicular to bladed crystals and sheaf-like aggregates in the pegmatite. The pegmatite at the contacts with the quartz schist has a fine grain size and only a small amount of felspar and shows the sporadic development of small grains of a light red amphibole. With the increase in grain size of the pegmatite away from the contacts, coarser aggregates of the light red amphibole are noticed. In the central portions of the pegmatite the amphibole present is of a deep red variety associated with idiomorphic crystals of Blanfordite. Abundant radiating aggregates of Winchite and scales and plates of Manganophyllite are developed at the contact of the pegmatite with the manganese ore body. In this region there is a marked increase in the size and abundance of the idiomorphic crystals of the manganese pyroxene—Blanfordite. It may be mentioned here that the occurrence of Winchite from the Kajlidongri area described by Dr. Fermor[1] is in schists and quartzites, and not in a pegmatite.

*Winchite* (cf. *Richterite*)[2].—Occurs as slender elongated prisms and in radiating aggregates. Prismatic cleavage and parting across the length. Specific gravity: 2·95. Deep to light bluish violet in colour and vitreous lustre. Hardness: about 6.

*Optical characters.*—Strongly marked pleochroism with $X$ = rose pink, $Y$ = light pinkish, $Z$ = blue; absorption: $X > Z > Y$; biaxial negative; axial plane normal to (010); extinction angle in some crystals (var. B) is $X \wedge C = 19\text{-}30°$ and the elongation is negative, in others (var. A) the angle $Z \wedge C = 30\text{-}38°$ and the elongation is positive. This variation in optical orientation and sign of the crystals in one and the same section was noticed by Dr. Fermor[1] in the Kajlidongri Winchite and these were designated by him as basic (var. B) and acid (var. A) varieties. Axial angle large; refractive indices: $\alpha = 1·61\text{-}1·62$; $\gamma = 1·62\text{-}1·63$; birefringence: ·020 (B) and ·013 (A); MnO % in the Winchite is 1·18.

*Deep Red Amphibole:* cf. Eckermannite, var. Imerinite)[2].

Occurs as disseminated small grains and sometimes in elongated prismatic aggregates upto 3″ in length. Prismatic cleavage. Specific gravity 3·24 (of prismatic aggregates). Hardness about 6. Deep brownish red in colour and vitreous lustre.

*Optical characters.*—Distinct pleochroism with $X$ = pink, $Y$ = light red, $Z$ = brownish red; absorption: $X > Z > Y$; biaxial negative; axial plane normal to (010), negative elonga-

tion with $X \wedge C = 28°$; refractive indices: $\alpha =$ slightly more than $1·66$, $\gamma =$ between $1·63$-$1·69$; birefringence: $·024$ to $·026$; axial angle large; MnO % $4·38$.

*Light Red Amphibole*: (cf. Anophorite).[2]

Occurs as disseminated small grains and sometimes as small slender prisms less than a centimetre in length; prismatic cleavage at $58° 30'$; rose red in colour and vitreous lustre.

Optical Characters.—Distinct pleochroism with $X =$ rose pink; $Y =$ light pink; $Z =$ colourless to pale; absorption; $X > Y > Z$; biaxial negative; negative elongation with $X \wedge C = 18°$; optic axial plane normal to (010); optic axial angle large; refractive indices: $\alpha = 1·65$-$1·66$; $\gamma = 1·67$-$1·68$; birefringence: $·011$-$·013$; MnO % $= 0·995$.

### DISCUSSION

The Winchite from M.P. described in this paper agrees with that of the Kajlidongri specimen described by Dr. Fermor[1] in all essential physical and optical characters. Our specimen has a slightly higher MnO content, *viz.*, $1·18\%$, as against $0·77\%$ in the Kajlidongri specimen. The variation in the optic orientation and sign in the two varieties (acid and basic of Dr. Fermor) may be reasonably explained by the comparatively low double refraction on account of which "only small differences in the chemical composition may bring about a change in the mutual size of the chief indices".[2] The affini-

ties of Winchite with Richterite were noticed by Dr. Fermor.[1] A critical comparative study of the optical and chemical characters of the Winchites of Ponia and Kajlidongri with that of Richterite from Längban[2] clearly indicates the very close similarity between the minerals. The deep red and light red amphiboles closely associated with the Winchite may be considered as varieties on account of their distinct physical and optical characters. It is also seen that the deep red variety approaches Eckermannite (var. Imerinite)[2] in essential characters and the light red amphibole is near Anophorite indicating clearly that these two amphiboles are in all probability intermediate members of the Eckermannite-Arfvedsonite series.

In conclusion it may be said that in the Ponia pegmatite there occurs an isomorphous series of manganese amphiboles lying in between Richterite at one end and Arfvedsonite at the other. A detailed optical and chemical study of these amphiboles and their paragenesis will be published in due course. A re-investigation of the Blanfordite associated with these amphiboles is also being completed and will form the subject-matter of another paper.

1. Fermor, L. L., *Mem. Geol. Surv. Ind.*, 1909, **37,** I, 145-160, 150, 151-158, 158.
2. Sundius, N., *Sver. Geol. Und. Arsb.*, 1946, **60,** No. 4, 7-9, 9-10, 14, 14, 8, 9-10.

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## VITAMIN-C REQUIREMENTS

IN an attempt to determine the minimum vitamin C requirements of man, the British Medical Research Council organized, through the Accessory Food Factors Committee, a clinical trial on human volunteers. The investigation was carried through at the Sorby Research Institute, Sheffield, between 1944 and 1946 under the direction of Professor H. A. Krebs, one of last year's Nobel Laureates in Medicine. The full report, which has recently been published (*Special Report Series*, Medical Research Council, London, 1953, No. 280) is a monumental work extending almost to 200 pages. The report concludes that the minimum protective dose, measured by the presence or absence of the signs of scurvy, is in the region of 10 mg. daily. Further, in order to arrive at a figure for a daily allowance which covers individual variations and includes a safety margin, it is

suggested that the minimum protective dose of 10 mg. be trebled. An allowance of 30 mg. daily is in accordance with the recommendation by the League of Nations Health Organization Technical Commission on Nutrition made in 1938.

This dose is much less than 75 mg. per day which had previously been recommended by the U. S. National Research Council. Commenting on this, the *British Medical Journal* (April 3, 1954) observes that no one has yet succeeded in demonstrating the slightest traces of ill-effect with intakes of that order or even appreciably below it. It cannot be entirely ruled out as a possibility that a higher intake may be advantageous in order to provide a presumed "optimum" as distinct from a mere "adequacy", but this has not yet been conclusively proved.

# CYTOLOGY OF SEMISTERILE RICE HYBRIDS

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*Central Rice Research Institute, Cuttack*

SINCE 1950 a scheme for breeding high-yielding types of rice, by hybridizing Japanese or *japonica* varieties of rice with tropical or *indica* varieties of rice is being conducted at the Central Rice Research Institute, Cuttack. In these inter-racial crosses, varying degrees of sterility occurs in the $F_1$ and in many of the subsequent progenies. The occurrence of semi-sterility in such crosses is well known and it is also known that the environmental conditions affect the extent of sterility. In addition to the environment, it is probable that genic, chromosomal, and cytoplasmic factors control the extent of sterility. An interpretation of rice hybrid semi-sterility on basis of three pairs of genes has been attempted by Kuan Jen Hsu.[2] The evidence for the part played by chromosomal and cytoplasmic factors is presented.

For chromosomal study PMC division was examined from acetocarmine mounts and paraffin sections. Eighty-five hybrid combinations showing 25-99 per cent. spikelet sterility were studied, out of a large number of hybrids produced by crossing eight improved types of rice from Japan with about 50 types of rice from India, Burma, Ceylon, Malaya, Pakistan, Thailand, Indonesia, Indo-China and Philippines. In all these hybrids, chromosome pairing was found to be normal in the MI stage, twelve bivalents being formed. However, in all the cells two or three pairs of chromosomes showed loose pairing having not more than one terminal chiasma each. Even in diplotene, one or two bivalents had a single terminal chiasma. These pairs can be pressed apart in smearing and also were observed as univalents in some cells (Fig. 1). In the first anaphase of this



FIG. 1. MI. $F_1$ Taichu 65 × Adt. 12, acetocarmine mount bivalents pressed apart, ×2,750.

division, abnormalities were present in some of the cells of most of the hybrids. These abnormalities are classifiable as presence of lag-gards, stretched chromosomes, and anaphase bridges with fragments (Fig. 2). Total num-



FIG. 2. AI. F Norin 20 × Khabu das, anaphase bridge with fragment, × 2,750.

ber of cells in AI stage observed were 5596. In 33 hybrid combinations irregularities were found in more than 10 per cent. of cells observed, and anaphase bridge with fragment was found in eleven combinations.

As a result of this detailed study, it is possible to make the following inferences: The occurrence of anaphase bridges must be due to presence of inversions in some chromosomes. Rice cultivation was introduced into Japan from the mainland and the *japonica* types were evolved under Japanese agricultural conditions. Under these conditions structural changes in chromosomes including inversion of segments have been selected and preserved in a homozygous condition. On crossing with *indica* types, crossing over between inverted and corresponding normal segment would tend to cause formation of anaphase bridges.

The presence of cryptic structural differences between chromosomes of different races of rice has been conjectured by Japanese workers and the previous work discussed by Cua.[1] The present work gives evidence for presence of one type of structural change, *viz.*, inversion. The study is being continued for detecting other types of changes. It is evident that the $F_2$ and later progenies may carry chromosomal changes like deletion and duplication. How far the new chromosome combinations are viable is unknown.

It is not suggested that Japanese rice varieties alone have undergone chromosomal changes, or that all the varieties have undergone the

same type of change. The anaphase bridges recorded by Mello Sampayo[3] in hybrids between two *japonica* types of rice brings out this complexity. The Japanese varieties are however characterised by a group of morphological and physiological characters and are normally interfertile.

The part played by cytoplasmic factor was observed recently at Central Rice Research Institute, Cuttack.[4] This was detected by differences in extent of grain setting in reciprocal crosses. In order to find out if gametic fertility is affected by the cytoplasm, the

| Cross combination | Mean % | S.E. |
|---|---|---|
| *Rikuu* 132 × *Adt.* 18 | 84 | 1·7 |
| *Adt.* 18 × *Rikuu* 132 | 69 | 1·6 |
| *Gimbozu* × *T.* 1145 | 50 | 1·3 |
| *T.* 1145 × *Gimbozu* | 28 | 2·6 |

crosses, *Rikuu* 132 (Japan) × *Adt.* 18 (Madras) and *Gimbozu* (Japan) × *T.* 1145 (Orissa) and their reciprocals were studied for pollen sterility. The data of pollen sterility as shown by iodine mounts are as follows:

The differences between reciprocal crosses when grown under identical conditions is statistically significant and therefore shows that the cytoplasm as transmitted by the female parent has an effect on pollen development in the $F_1$ generation.

We are indebted to Dr. N. Parthasarathy for facilities and to the FAO of the United Nations Organisation for financing the scheme.

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## LADY TATA SCHOLARSHIPS AND GRANTS FOR 1954-55

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1954, the awards of Scholarships and Grants for the year 1954-55.

The International Awards of varying amounts totalling ( £ 6,275) for research in diseases of the blood with special reference to Leucaemias are made to Doctors J. F. Kieler (Denmark), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), R. Rask-Nielsen (Denmark), R. Robineaux (France), J. Nordmann (France), N. A. Stenderup and F. Kissmeyer-Nielsen (on a joint research project) (Denmark), J. Ring-

sted (Denmark), J. Rygaard (Denmark), M. Seligmann (France), G. Negroni (of Italy, working in England), and Dr. A. Sreenivasan (Bombay).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Dr. (Mrs.) M. Aikat (Gwalior), Miss K. S. Laul (Bombay), Mr. P. R. J. Gangadharam (Bangalore), Mr. N. V. Bringi (Bombay), Dr. R. S. Grewal (Lucknow), Mr. N. A. Nityananda Rao (Bangalore), and Mr. T. K. Sundaram (Madras).

## SOLAR BATTERY

THE Bell Telephone Laboratories have announced the invention of an electric battery which uses sunlight as its fuel, and which develops enough power to run toys or transmit voices for short distances over wires. An efficiency of 6 per cent. is claimed for the battery in converting sunlight directly into electricity, which compares favourably with the efficiency of steam and petrol engines in contrast with other photo-electric devices, which have a rating of no more than 1 per cent.

The experimental solar battery uses strips of wafer-thin silicon about the size of a com-

mon razor blade. These strips are highly sensitive to light, and can be linked together electrically and deliver power from the sun at the rate of 50 watts per square yard of surface.

The solar battery, along with other silicon devices demonstrated at the laboratories, would seem to be an offshoot of a broad study of silicon and its possible application in modern electronics. An important feature of these silicon devices is that they can operate at much higher temperatures than other crystal rectifiers now in use.

# LETTERS TO THE EDITOR

## HYDRODYNAMICAL GENERALIZED SINGULAR POINTS

IT is not generally realized that the introduction of the idea of generalized singular points simplifies problems in classical hydrodynamics to such an extent that most of the results of the linear theory can be reproduced without any effort. It is known that non-viscous flows can be produced by a suitable distribution of singular points like sources, sinks, doublets and vortices. But, except in the case of simple boundaries like a plane, a sphere or a cylinder, such distributions are infinite in character and hence are of not much practical importance. A generalization of such singular points as ultimate forms of closed surface bodies reduces the infinite number of spherical or circular points to a single generalized point. For example, the uniform motion of an ellipsoid in a non-viscous liquid can be produced by a single ellipsoidal doublet in the same manner as that of a sphere by a spherical doublet. In all such cases the potential of the generalized source is the same as the static potential at an external point of a closed body whose ultimate form is the generalized source. For motion of rotation the generalized doublet is replaced by a generalized vortex.

For slow viscous motion the equations are linear and the corresponding solution can be obtained by superposing on the doublet a solution due to a concentrated force in an infinite

elastic body (viscous liquid). Furthermore, it is found that the concentrated force is the drag suffered by the body. For example, for a sphere of radius $a$ moving with velocity U the irrotational doublet solution is[1] :

$$u_1 = -\tfrac{1}{2}U\left(\frac{a}{r}\right)^3 + \frac{3}{2}U\frac{x^2}{a^2}\left(\frac{a}{r}\right)^5,$$

$$v_1 = \frac{3}{2}U\frac{xy}{a^2}\left(\frac{a}{r}\right)^5,$$

$$w_1 = \frac{3}{2}U\frac{xz}{a^2}\left(\frac{a}{r}\right)^5.$$

The solution for a concentrated force P acting at the origin along the $x$-axis is :

$$u_2 = \frac{p}{8\pi\mu}\left(\frac{x^2}{r^3}+\frac{1}{r}\right), \quad v_2 = \frac{P}{8\pi\mu}\frac{xy}{r^3},$$

$$w_2 = \frac{P}{8\pi\mu}\frac{xz}{r^3},$$

$\mu$ being the rigidity (viscosity). Putting $u = Au_1 + u_2$, etc., the boundary conditions immediately give $A = -\tfrac{1}{2}$ and the drag as $P = 6\mu\pi aU$. Similar results can be obtained for an ellipsoid. For a cylinder, as we know from the theory of elasticity, the concentrated force solution is defective at infinity where $u_2$ becomes infinite. But near the surface of the body it is considered quite good.

For any body whose surface in orthogonal curvilinear co-ordinates, $\xi, \eta, \zeta$ is given by $\xi = a$ and whose potential at an external point, V, is $x\, \alpha\, (\xi)$, the irrotational flow potential for motion along the $x$-axis is $-\partial V/\partial x$. The corresponding slow viscous flow is given by

$$u = A\frac{\partial V}{\partial x} - \frac{P}{8\pi\mu}\left[\frac{\partial}{\partial x}(x\psi) - 2\psi\right]$$

$$v = A\frac{\partial V}{\partial y} - \frac{P}{8\pi\mu}\frac{\partial}{\partial y}(x\psi)$$

$$w = A\frac{\partial V}{\partial z} - \frac{P}{8\pi\mu}\frac{\partial}{\partial z}(x\psi),$$

where $\psi$ is the solution in the orthogonal curvilinear system, which is a function of $\xi$ only, and where

$$A = \frac{\psi_0'}{\psi_0 a_0' + \psi_0' a_0}, \qquad \psi_0' = \left(\frac{\partial\psi}{\partial\xi}\right)_{\xi = a_0}.$$

The drag is given by

$$P = \frac{8\pi\mu a_0' U}{\psi_0 a_0' + \psi_0' a_0}.$$

In the case of cylinders the factor $8\pi$ is replaced by $4\pi$. For motion of rotation the concentrated force is replaced by a "generalized centre of rotation".

These results reduce classical hydrodynamics to the determination of only two types of statical solutions, and hence can be of great use both at the undergraduate and at the post-graduate level of teaching. By analogy with results in the theory of elasticity they also bring out the well-known results that for linear viscous flow the velocity components should be small and that near the surface of the body Stokes's solution is a sufficiently good approximation.

Indian Inst. of Tech.,      B. R. SETH.
Kharagpur, *April* 12, 1954.

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## INFLUENCE OF MECHANICAL PRESSURE ON BARRIER HEIGHT IN GALENA RECTIFIERS

PRECISE quantitative information regarding dependence of barrier height on the mechanical pressure with which the whisker is engaged to the crystal (rectifier) is meagre. A detailed investigation was therefore undertaken employing in the first instance Galena rectifiers with whiskers of platinum, aluminium and carbon. After selecting a proper point[1] of contact on the crystal surface, mechanical pressure was adjusted carefully. It was found from the D.C. characteristics that there exists an optimum pressure at which the degree of rectification is maximum (Fig. 1 $a$, $b$). Following
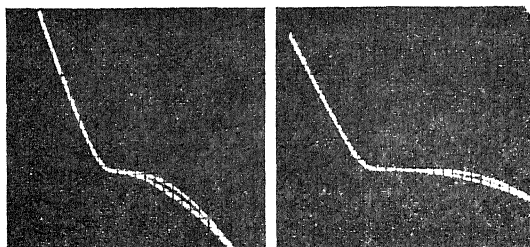


FIG. 1. (*a*) Lower pressure.    FIG. 2. (*b*) Optimum pressure.

Gibson,[2] we have determined the barrier height as a function of mechanical pressure from the current-voltage characteristics in the easy flow direction. Table I shows that the barrier height increases initially with pressure ; reaches a maximum value and then decreases with a further increase in the mechanical pressure. It is interesting to note that the optimum pressure is characterised by maximum barrier height and minimum spread resistance at the point of contact. Similar results are obtained with aluminium and carbon whiskers.

| Pressure (g. weight) | Barrier height $\phi$ (volts) | Spread resistance $R_s$ (ohms) |
|---|---|---|
| 30 | 1·275 | 82·10 |
| 50 | 1·320 | 26·90 |
| 70 | 1·698 | 25·40 |
| 90 | 1·780 | 22·37 |
| 110 | 1·830 | 15·61 |
| 130 | 0·560 | 53·94 |
| 150 | 0·320 | 67·55 |

These results suggest that the barrier height is not entirely due to the difference in the thermionic work functions[3,4] of the crystal and the metal whisker, but is also determined partly by the proximity of the whisker. Bardeen[5] with his postulate of large number of surface states at the crystal surface has shown that the barrier height does not depend on the nature of the metal of the whisker.[6] The observed dependence of the barrier height on the whisker pressure indicates that the surface states are affected to a certain extent by the intimacy of the contact between the crystal and the metal whisker.

Further work with other crystal rectifiers is in progress.

Our grateful thanks are due to Dr. V. N. Thatte for his kind interest and guidance.

Dept. of Physics,      J. N. DAS.
College of Science, Nagpur,    V. G. BHIDE.
*March 26, 1954.*

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## CATALYSED POLYMERISATION OF STYRENE IN TOLUENE

THE use of phenylazotriphenylmethane as a catalyst for the polymerisation of styrene was first reported by Schulz.[1] As is well known, the catalyst on heating can give rise to two transient free radicals in solution :

$$Ph \cdot N = N \cdot CPh_3 \longrightarrow Ph \cdot + N_2 + \cdot CPh_3$$
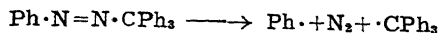
These free radicals can act as initiators in addition polymerisation and will thus get incorporated in the polymer molecule.[2]

According to Schulz,[1] upto a concentration of $3 \times 10^{-5}$ mole azo compound per mole of styrene, the initiation reaction in the bulk polymerisation of styrene is monomolecular with respect to the catalyst concentration.

The use of catalysts in studying the chain-transfers of monomers with different solvents was first envisaged by Mayo.[3] We have also studied the chain transfer reaction between growing styrene (M) polymer radical and toluene (S), when catalysed by different quantities of the catalyst (B), phenylazotriphenylmethane. According to Eyring et al.[4] the following equation is arrived at for a catalysed reaction in a solvent, on the basis of a bimolecular initiation :

$$\frac{1}{P} = \frac{(k_i k_t)^{1/2}}{k_p} \cdot \frac{B^{1/2}}{M^{1/2}} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M} \quad (1)$$

If, however, the idea of a monomolecular initiation as advanced by Schulz is accepted, the equation can be written as below :

$$\frac{1}{P} = \frac{(k_i k_t)}{k_p} \cdot \frac{B^{1/2}}{M^{1/2}} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M} \quad (2)$$
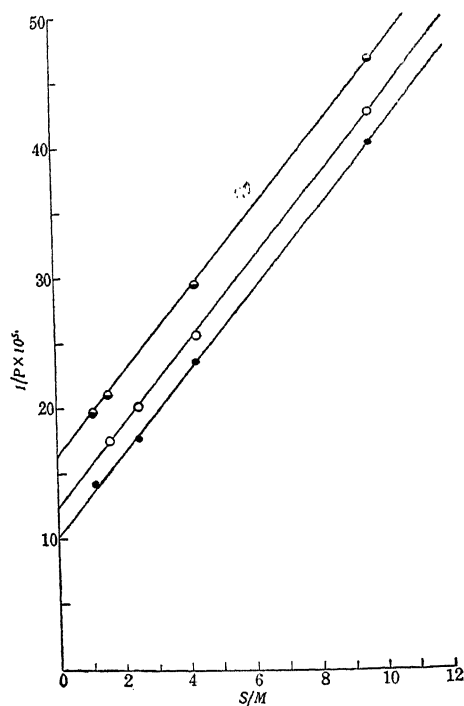


FIG. 1. Temp. 80° C.

$\sqrt{(B/M)}$ values: ◖ $7·941 \times 10^{-3}$ ; ○ $3·213 \times 10^{-3}$
$(C \times 10)^5$     ;    3·10    ;   3·13

                ; ● nil
                ; 3·10

equations C is the chain-transfer
is equal to $k_{tr'}/k_p$. The other
: the usual significance.
ent studies it has been shown that
:onstant, calculated from the slope
t S/M plots at constant $\sqrt{(B/M)}$
C. is not appreciably affected by
of low concentrations of the cata-
graphically illustrated in Fig. 1.
seen that all the curves are paral-
her, and their slope remains prac-
ame as in the case of the un-
:tion.
; been made as to whether the
ction is monomolecular or bi-
hen $1/\bar{P}$ is plotted against $\sqrt{(B/M)}$
of constant S/M values the plots
be linear and parallel to each
ie other hand, the plots of $1/\bar{P}$
I, for a series of constant S/M
ςh linear, have different slopes.
hat equation (1) and not (2) is
the present case. The evidence
your of a bimolecular initiation.
hanks of the authors are due to
Chatterji for facilities.

mistry,       R. N. CHADHA.
versity,       G. S. MISRA.
*rch* 16, 1954.

*turwiss.*, 1939, **27**, 659.
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Harman, Tobolsky and Eyring, *Ann.
d. Sci.*, 1943, **44**, 371.

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## PMENT OF THE EMBRYO
## CCULUS VILLOSUS DC

e and development of the ovule
sac[1] and microsporogenesis[2] in
osus DC have already been de-
Ibryo development has not been
ar. A brief description of the
of the embryo of this plant is
e.

The zygote divides transversely and gives
rise to two superposed cells, the apical cell *ca*
and the basal cell *cb* (Fig. 1). Each of the
cells of the two-celled proembryo divides by
an obliquely vertical wall (Figs. 2 and 3). The
two daughter cells of the basal cell undergo
a transverse division resulting in the formation
of two superposed tiers of cells, the upper *m*
and the lower *ci* (Figs. 5 and 6). Tier *m* con-
tributes to the formation of the hypophyseal
region. The lower tier *ci* undergoes a number
of transverse divisions (Figs. 6, 7, 8 and 9)
and forms an elongated suspensor.
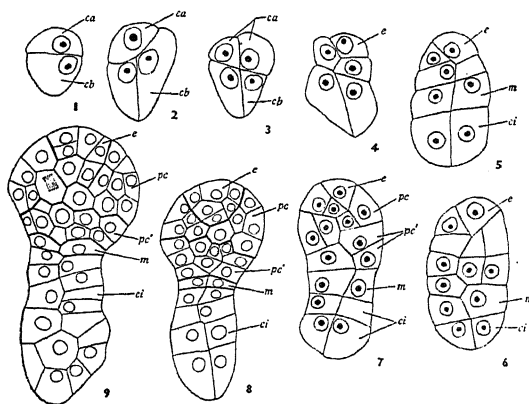


FIGS. 1–9. Various stages in the development of the
embryo.

FIGS. 1–7, × 365; FIGS. 8 and 9, × 255.

The two juxtaposed cells derived from the
apical cell undergo one oblique division each
(Figs. 4 and 5) and give rise to a triangular
epiphyseal initial *e'* and three subepiphyseal
cells. The epiphyseal initial divides in various
planes (Figs. 7, 8 and 9) and forms the stem
apex. The divisions in the subepiphyseal cells
are rather irregular (Fig. 6). However, ulti-
mately they give rise to two distinct tiers of
cells : the upper *pc* forming the central cylin-
der of the stem and the lower *pc'* giving rise
to the hypocotyledonary region (Figs. 7,
8 and 9). The following scheme summarises
the derivation of the various organs of the
mature embryo from the proembryonic cells :

```
                    / e  ----stem tip
           ca— pc ----central cylinder of the stem and cotyledons
          /     \ pc' ----hypocotyledonary region
celled proembryo<
          \      / m  ----hypophyseal region
           cb<
              \ ci ----suspensor
```
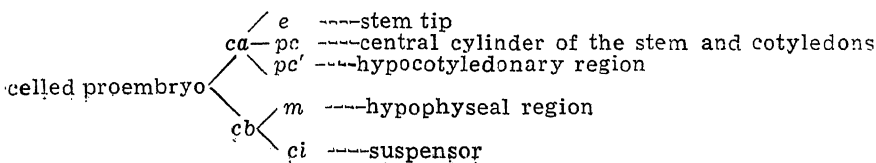
The embryo development conforms to the Onagrad type of Johansen[3] and keys out to the Trifolium variation. The embryo development of *Tiliacora racemosa* studied by the author[4] also conforms to the Trifolium variation of Onagrad type. It may be mentioned that both *Cocculus* and *Tiliacora* belong to the same tribe, Cocculeæ.

The writer is indebted to Prof. J. Venkateswarlu for suggesting the problem and for his guidance.

Dept. of Botany,                    R. L. N. SASTRI.
Andhra University,
Waltair, *March* 22, 1954.

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## SUPPLEMENTARY VALUE OF LUCERNE AT DIFFERENT LEVELS IN THE POOR RICE DIET

IN an earlier study,[1] it was shown that lucerne powder (*Medicago sativa* Linn.) is an excellent supplement to the poor South Indian rice diet when fed at 10 per cent. level. It was further shown that the beneficial effects of lucerne supplements are maintained in successive generations of rats. In this note, the results of an experiment designed to determine the optimum level of lucerne supplements in rice diet are reported.

Freshly weaned albino rats weighing 40-50 g. were distributed into seven comparable groups of six each. The animals were fed *ad libitum* on (*i*) the South Indian rice diet which had the same composition as that adopted by the Vanaspati Research Committee of the Ministry of Food[1] and (*ii*), (*iii*), (*iv*), (*v*), (*vi*) and (*vii*) the same diet in which rice constituting 2, 4, 7, 10, 13 and 16 per cent. respectively of the diet was replaced with equivalent amount of lucerne powder. The basal diet was prepared as described earlier. Weighed amounts of the lucerne supplements were cooked in separate beakers over a water-bath and then mixed separately with the basal diet. The re-

sults of the experiment for a period of 8 weeks are shown below:

| Group No. | Lucerne powder in rice diet % | Average daily food intake (g.) | Average weekly growth of rats (g.) |
|---|---|---|---|
| I | 0 | 7·1 | 4·2 ± 0·48* |
| II | 2 | 8·3 | 8·1 ± 0·59 |
| III | 4 | 9·9 | 11·4 ± 0·67 |
| IV | 7 | 10·8 | 12·3 ± 0·86 |
| V | 10 | 10·5 | 11·4 ± 0·62 |
| VI | 13 | 9·6 | 10·6 ± 0·66 |
| VII | 16 | 10·8 | 11·8 ± 0·75 |

* Standard error of the mean.

The critical difference for comparing the average weekly gains in weight of any two groups works out to be 1·93 g. It will be seen therefore that while there was a significant difference between the groups I & II, and II & III, there was no significant difference between any two of the groups III-VII. The rate of growth of animals receiving the rice diet was doubled on giving 2 per cent. lucerne supplement and increased threefold when 4 per cent. lucerne was given. Any further increase in the proportion of lucerne did not significantly improve the rate of growth of the animals. Therefore, lucerne is a very good supplement to the poor rice diet even at low levels, the optimum level for supplementation being 4 per cent.

Central Food Tech.              B. K. SUR.
    Res. Institute,             V. SUBRAHMANYAN.
Mysore, *March* 23, 1954.

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## THE REACTION BETWEEN PYRIDINE AND METHYL IODIDE

THE formation of pyridine methiodide has been the subject of extensive investigations but in a fair proportion of the earlier work there is no clear indication whether the work has been really under homogeneous conditions. Edwards[2] clearly demonstrated the importance of this aspect of the problem in his study of the formation of phenyl trimethyl ammonium iodide and Davies and Cox report work under strictly homogeneous conditions for the same reaction.[1] No such work is available for the reaction

TABLE I

| | Initial concentration moles/l. | | Temperature °C. | Bimolecular rate constant $k_2 \times 10^5$ | Arrhenius activation energy k cals. | $\log_{10}$ frequency factor |
|---|---|---|---|---|---|---|
| | pyridine | Me-I | | | | |
| A. Solvent : Acetone | 0·09727 | 0·08280 | 40 | 58·43 | | |
| | 0·09790 | 0·08549 | 50 | 111·4 | 11·280 | 4·71 |
| | 0·08459 | 0·07920 | 60 | 193·5 | | |
| B. Solvent : 95% Ethyl Alcohol | 0·09480 | 0·08563 | 40 | 8·67 | | |
| | 0·09893 | 0·08539 | 50 | 20·95 | 17·820 | 8·41 |
| | 0·09194 | 0·07698 | 60 | 48·35 | | |

under investigation. Further the influence of solvent on this reaction has not been fully elucidated.

Hinshelwood[5] considers that the solvent functions primarily for energy transfer while Harman Stewart, and Ruben using an isotopic tracer technique report the formation of an intermediate complex in all Menschutkin reactions.[4]

Since the reaction leads to the production of ions, it may be inferred that the ionisation of the alkyl halide is a significant step and any solvent that could stabilise the ions by solvation will favour the reaction. Further, it is difficult to decide whether the reaction is an ion-dipole or a dipole-dipole reaction. Eyring and co-workers[3] using the relationship between the rate constant and $(D-1)/(2D+1)$ consider that the reaction is of the dipole-dipole type. From kinetic considerations it can be shown that the reaction will be of the second order only if the reaction is initiated by the prior polarisation of the methyl iodide. Ninety-five per cent. alcohol and pure acetone have been chosen in the present study and the course of the reaction has been followed by the estimation of the iodide ions formed. The results obtained are summarised in Table I A and B.

The high activation energy noticed in alcoholic solutions as well as the lower value in acetone are quite consistent with earlier work but it will be noticed that in spite of the low frequency factor in acetone the reaction is faster in this solvent. The dominant factor is thus seen to be the activation energy of the reaction. In both cases the mechanism appears to require solvation of the activated complex in the transition state, though different pictures are necessary for the proper interpretation.

A fuller account of the experimental details and the discussion of the results will appear elsewhere.

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Dept. of Chemistry, V. S. PADMANABHAN.
Madras Christian College,
Tambaram, *April* 21, 1954.

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## ANTIBIOTICS IN CALF NUTRITION

IN recent years, a number of investigations have been carried out to study the effect of adding small quantities of antibiotics in the diet on the growth and health of young calves.[1] So far, no such studies have been reported in this country. A gift of Aurofac (product of aurcomycin fermentation) made by M/s. Lederle Laboratories (India), Ltd., offered us an opportunity to study its growth and health-promoting values on calves born in the Institute farm.

Calves of both sexes immediately after weaning were selected and divided into two groups—control and experimental. The grouping was so made that each animal in one group had a counterpart in the other in regard to sex and breed, and as close as possible, to initial body weight and size. The selected calves irrespective of their grouping were fed during (*i*) the first 30 days : whole milk adjusted to 3·7 per cent. fat, at 10·0 lb. for Sindhi and Gir and 12·5 lb. for cross-bred calves per 100 lb. body weight, (*ii*) the second 30 days : whole milk adjusted to 3·7 per cent. fat + skim milk

(3 : 1), at 7·5 lb. for Sindhi and Gir and 10·0 lb. for cross-bred per 100 lb. body weight. The calves were also induced to eat solid feeds in the form of a soaked concentrate mixture of crushed oats, groundnut cake and wheat bran (3 : 1 : 1), green lucerne and ragi straw, and (*iii*) the last 30 days : whole milk adjusted to 3·7 per cent. fat + skim milk (1 : 1), at the same rate as in (*ii*), and solid feeds as mentioned above in measured quantities. The animals in the experimental group received in addition a supplement of Aurofac at the rate of 10·0 g. per 2·5 lb. of dry solid consumed. According to the manufacturer, a pound of Aurofac contains not less than 1·8 mg. vitamin $B_{12}$ and 1·8 g. aureomycin.

The results so far obtained with 12 calves equally divided between the control and experimental groups during the 90-day observation are as follows :

(*a*) The calves receiving the Aurofac supplement, with initial mean body weight of 51 lb., gained 0·82 lb./calf/day whereas those in the control, with initial mean body weight of 50 lb., gained 0·48 lb./calf/day. The difference in the two growth rates was statistically examined by the analysis of variance and found significant at 5 per cent. level. (*b*) The improved growth rate of Aurofac-supplemented calves was also reflected in the body measurements taken initially and at the end of the observation period. The average percentage gain in height, length and girth was 17, 23 and 28 respectively for the experimental group as compared to 10, 18 and 20 respectively for the control. (*c*) The average per head consumption of milk per pound of gain in body weight was 10·6 lb. and 21·3 lb. for experimental and control groups respectively. (*d*) The calves receiving the Aurofac supplement took to non-milk solid feeds earlier and more readily than those in the control. (*e*) Throughout the entire period of observation, the calves receiving the Aurofac supplement showed no signs of digestive trouble. Five out of six calves in the control group, however, suffered from attacks of scour of varying degrees. (*f*) Aurofac supplementation in the diet had apparently no protective action against common cold, because calves in both the groups suffered from the same at one time or the other of the observation period. (*g*) The Aurofac fed calves showed more shine in their coat, looked more thrifty and generally appeared of better body-built than the control animals. The details of the work will be published elsewhere.

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## USE OF OUDIN'S GEL DIFFUSION TECHNIQUE FOR DETERMINATION OF PURITY OF PROTEINS AND POLYSACCHARIDES

IMMUNOLOGICAL techniques are more specific and more sensitive than physical methods for assessing the homogeneity of biological samples.[1] The simplest and probably the most useful of these is that worked out recently by Oudin,[2] in which the antigenic material and its antisera are allowed to diffuse towards each other through an intervening layer of agar gel and the proteins or polysaccharides in the test material form sharply defined lines of precipitation when they meet their respective antibodies. A single pure substance does not give rise to more than one line, and also there is no Liesegang ring phenomenon in the system.[3] The
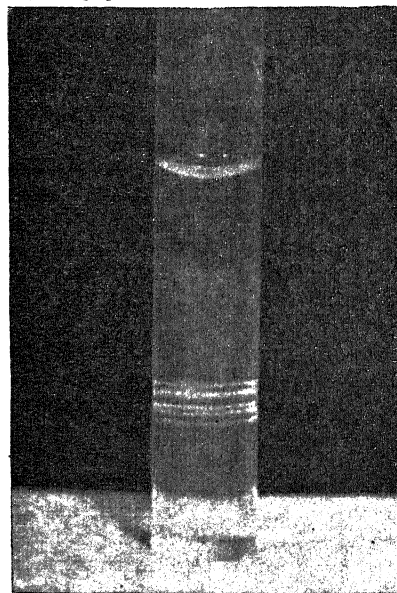


number of lines indicate the minimum number of antigens in the substance under test and the position of a particular line depends only on the relative concentration of the antigen and its antibody.

The technique used in our laboratories is a slight modification of Bowen's procedure.[4] A stock solution of 1·6 per cent. filtered agar was melted and maintained at 50° C. To this was added antisera in the ratio of 0·7 ml. of antisera to 0·3 ml. of melted agar. 0·5 ml. of this mixture was poured carefully into narrow test-tubes 8-10 mm. diameter and 8-10 cm. long. When the layer had set, 1 ml. of plain filtered 0·8 per cent. merthiolated agar was poured over the first layer and allowed to set. 0·5 ml. of antigen solution was then added and the tubes were sealed and kept in incubator at 37° C. The number and intensity of the lines in the middle layer were read after 3 days, 7 days and 15 days.

The antisera were prepared by repeated subcutaneous and intravenous injections of the antigenic material into rabbits. The antisera obtained from several bleedings were pooled and preserved with 0·01 per cent. merthiolate.

Using Oudin's technique we determined the number of components and the common antigens in the venoms of the poisonous snakes of India, *viz.*, cobra, krait, Russell's viper and *Echis carinatus*. Results are summarised in Table I.

TABLE I

*Results of Oudin's gel diffusion technique with venoms*

|  | Cobra venom | Krait venom | Russell's viper venom | Echis venom |
|---|---|---|---|---|
| Cobra antisera .. | 7 | 3 | 1 faint | nil |
| Krait antisera .. | 2 | 7 | nil | nil |
| Russell's viper antisera .. | 1 faint | nil | 8 | 4 |
| Echis antisera .. | nil | nil | 5 | 7 |

It is seen from the table that there are at least three common antigens between the venoms of cobra and krait both of which belong to the family *Elapidæ* and there are about five common antigens between the venoms of Russell's viper and *Echis carinatus,* both of which belong to the family *viperidæ*. However, there was a faint indication of one common antigen between cobra and Russell's viper venoms. Details will be published elsewhere.

Attempts are also being made to fractionate cobra and Russell's viper venoms using Oudin's technique as a criterion of the purity of the fractions.

The purification of Diphtheria toxoid by various methods has also been followed by Oudin's technique.

The authors are grateful to Dr. P. M. Wagle and Dr. A. K. Hazra for their encouragement and for providing facilities.

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## CHARACIOSIPHON FROM TIRUPATI

THE first report of this alga as a new genus of Chlorococcales was by Iyengar[1] from a shallow stream near Trichinopoly (S. India). There were no subsequent reports of this form.

Recently a note[2] about this genus with some interesting features appeared in *Current Science.* The interesting features were the robust size and the lobations of the thallus. Such lobing of the thallus was not described by Prof. Iyengar.

The writer collected this alga in a semi-permanent stream from Tirupati during the monsoon months (October-December) 1952. The form was found growing both on stones, floating pieces of sticks and other objects like submerged leaves even epiphytically and disappeared quite quickly with the drying up of the stream. The present form showed no such lobations as described by Prof. Agarkar but differs in its size. The thalli of this place are longer than those described by both Iyengar and Agarkar measuring between 1·2 cm. to 1·3 cm. when full grown. But they are narrower than those described by Agarkar and slightly broader than those described by Iyengar measuring between 1·5-2 mm. when mature. A detailed account dealing with the life-history of the alga will appear elsewhere.

The writer is grateful to Prof. F. E. Fritsch and Prof. M. O. P. Iyengar for their kind help and to Dr. A. Ramakrishna Reddi for the kind facilities given.

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Tirupati, *December* 1, 1953.

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## CHEMICAL STANDARDS FOR COFFEE POWDER

THE analytical figures found to be most useful in testing the genuineness of coffee powder or estimating the amount of foreign adulterants in it, after detecting them microscopically, are: (1) water extract, (2) alkalinity of ash, (3) caffeine, and (4) fat content. Analysis of a large number of genuine and adulterated coffee powder samples received in this laboratory under the Madras Prevention of Adulteration Act during the last two decades showed that the water extract varied from 26 to 32 per cent.; alkalinity of ash (number of ml. of $n/10$ HCl required to neutralise the alkalinity of ash from 5 g. of coffee powder) from 18 to 24; fat from 10-15 per cent. and caffeine from 1·2-2·3 per cent.; but samples with caffeine content exceeding 2 per cent. were few. These figures generally agree with those published in text-books but the average caffeine content[1] given in some books is only 1·2 per cent., the maximum being 1·8 per cent.

With a view to fixing chemical standards for coffee powder, seeds of *C. arabica* and *C. robusta*, which are the important varieties grown in South India, were obtained from reliable sources, roasted and powdered for the experiments. The analytical figures of a few samples of each variety are given in the following table.

*Analytical figures for* C. robusta *and* C. arabica

| Variety of coffee | Serial number | Water extract | Alkalinity of ash | Caffeine % | Fat (petrol extract) % |
|---|---|---|---|---|---|
| C. *robusta* | 1 | 30·2 | 21·7 | 2·40 | 8·4 |
| do | 2 | 29·4 | 23·0 | 2·30 | 7·6 |
| do | 3 | 29·8 | 21·0 | 2·20 | 9·0 |
| do | 4 | 29·2 | 20·3 | 2·22 | 7·2 |
| do | 5 | 30·0 | 21·5 | 2·35 | 7·8 |
| do | 6 | 29·0 | 22·0 | 2·03 | 8·0 |
| C. *arabica* | | | | | |
| Plantation A | 7 | 30·0 | 19·2 | 1·30 | 15·7 |
| do | 8 | 29·2 | 21·6 | 1·30 | 12·5 |
| do | 9 | 26·3 | 20·1 | 1·45 | 11·5 |
| do | 10 | 28·9 | 22·3 | 1·27 | 12·9 |
| do | 11 | 29·5 | 22·6 | 1·39 | 12·7 |
| *Inferior variety* | | | | | |
| Black and bits | 12 | 30·0 | 25·5 | 1·62 | 11·3 |
| do | 13 | 32·6 | 26·9 | 1·65 | 11·3 |

The figures show that all the samples give more or less the same value for water extract and alkalinity although in samples 12 and 13, which were derived from a shrivelled and discoloured variety of seeds classified as black and bits, the alkalinity and caffeine content are distinctly higher than those for samples 7 to 11 prepared from *C. arabica*, which are much superior in flavour and quality. It is noteworthy that in samples 1 to 6 derived from *C. robusta* a high caffeine figure is associated with a low fat content (Petrol Extract). This fact does not appear to have been recorded so far. The high caffeine content of some genuine coffees observed by Venkatachalam and Sundaram[2] could probably be accounted for by the advent of more *C. robusta* on the market. It is stated that of the total acreage under coffee in South India, the area under *C. robusta* has increased from 10 per cent. in 1937 to 25 per cent. in 1947.

The fat content of *C. robusta* falls in the range of 7 to 9 per cent. Canada and some Australian States which have defined "coffee" to include *C. robusta* as in Madras State, have fixed for coffee powder a minimum fat content of 10 per cent. This figure appears to be too high and 7 per cent. would be a suitable minimum.

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## GLUCOFRUCTOSAN FROM *POLIANTHES TUBEROSA* LINN. AND GARLIC (*ALLIUM SATIVUM* LINN.)

BELVAL[1] isolated a polyfructosan from *Polianthes tuberosa* with the use of baryta. We have found that it can be done with greater facility by step-wise precipitation with ethanol.

The specific rotation $(\alpha)\,{}_{D}^{25°}$ of (*i*) polyfructosan (thrice precipitated from ethanol) was — 39·0°, (*ii*) its acetate (in $CHCl_3$), — 22·3°, (*iii*) the deacetylated material, — 39·6° and (*iv*), of (*iii*) after mild acid hydrolysis, — 84·4° (for acetylation and deacetylation see methods under reference[2]). The polyfructosan obtained after deacetylation was chromatographically pure, giving a single spot (Zero Rf; pure yellow with benzidine trichloracetic acid), but after mild acid hydrolysis contained, besides fructose (major fraction), also glucose (presence shown by chromatography and estimated to be 5 per cent. by Klein and Acree's method[3]). Thus, experimental proof has been provided for the first time that glucose is an integral part

of this polyfructosan molecule, though Belval[1] was the first to make this assumption on the basis of observed optical rotation of the hydrolysate of the polyfructosan.

Also, we have now found that the polyfructosan from garlic[4] contains combined glucose (chromatographic evidence); in the light of this evidence, the molecular configuration proposed by Kihara[5] for the polyfructosan from garlic, with fructose as the only structural unit, would need revision.

Our thanks are due to Dr. V. Subrahmanyan for his kind interest in the work.

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## *LOXOSTEGE MESSALIS* WALKER—A NEW CATERPILLAR PEST OF RAGI IN MYSORE STATE

AN unusual outbreak of *Loxostege messalis* Walker (Lepidoptera-Pyralidæ) occurred in Kolar District in 1952, when, specially during August-September, it covered over a thousand acres of ragi (*Eleusine coracana*), which is a very important staple food crop in Mysore State. Again in 1953 the insect re-appeared in great numbers in some of the areas (approximately over 250 acres) in which the pest had occurred during the previous year. This is the first record of this insect occurring in a pest form, and infesting ragi.

Hampson[2] recorded *L. messalis* from West Africa, North-West Himalayas, Punjab, Karachi, Poona, Ceylon and Australia. Fletcher[1] stated that it occurred throughout the plains of India and Ceylon, and that in Pusa the larvæ fed on the tender top leaves of maize plant. In the present case, the caterpillars were feeding extensively on ragi in Mulbagal, Srinivaspur and Chickballapur Taluks of Kolar District.

Except for the passing reference by Fletcher (1920), there seems to be no information concerning the life-history and habits of this species in the Indian literature. Eggs have not been observed. The young larvæ are about 1/6″, pale green and with a dark head.

The full-grown larvæ are about ¾″ long, pale green to brownish in colour with dark longitudinal lines on the dorsal and lateral sides, with the head dark, small and slightly pointed. The caterpillars attack the ragi crop in swarms. Each caterpillar spins a web across the upper side of the leaf, under the cover of which it feeds on the green tissues and skeletonises the leaf-blades. The injury is done so quickly, often within a couple of days, that the farmers imagine the pest to have migrated from the adjoining fields during the night. No general migrations of the larvæ have, however, been observed. The larval stage lasts about 2 weeks. Pupation takes place in a white silken cocoon either in the webbings made by the larvæ on the plants or underground, the latter being the more common. The pupæ are slender, brown, about ½″ in length; pupal stage occupies 10-12 days. Hampson[2] has described the adult moth.

Two Ichneumonid parasites, *Mesochorus* sp. and *Cremastis* sp. were obtained from the pupæ of *L. messalis*. Effective control of the pest was obtained by dusting the infested ragi fields with 5 per cent. BHC.

We are grateful to Sri. B. Krishnamurti, Government Entomologist, for facilities, and to the Director, Commonwealth Institute of Entomology, London, for identification of the insect species.

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## THE PRESENT SYSTEMATIC POSITION OF THE SUGARCANE LEAF-HOPPER *PYRILLA PERPUSILLA* WALKER

IN the literature on the insect pests of sugarcane in India, three species are recorded to be of common occurrence, *viz., Pyrilla perpusilla* Walker, *P. aberrans* Kirby and *P. pusana* Distant. Each of the three species is apparently found in abundance at a particular season of the year as mentioned by Misra[6] and Pruthi.[7] With reference to the controversy in regard to the number of species of *Pyrilla* found in India, the present work was undertaken to obtain a full and clear picture of the morphology of the adult males and females of *Pyrilla*

of the three so-called species, which have been recorded from various parts of India.

For the sake of convenience, we grouped the different types of *Pyrilla* under three separate categories or groups met with during different seasons of the year. The criterion for grouping them was on the basis of colour, number and size of spots and presence or absence of the apical cross-bands on the tegmina. In the first form, the apical margin of the tegmina is dark with prominent spots which also bears a pair of transverse bands formed by the fusion of contiguous spots. This form is in abundance in the fields during the rainy season, *i.e.*, between July to September and part of October. The second form of *Pyrilla* is the one with pale tegmina, but the apical margin is only very slightly darker than the rest of the tegmina and the spots are as prominent as in the previous case, but marked by the absence of the transverse bands. The spots are distributed in both the cases towards 1/3rd of the apical margin. The second group of *Pyrilla* is found during the period September to February of the following year. The third type is with light-coloured tegmina which are somewhat pale yellow, homogeneous in colour and the spots are minute and distributed up to near about the middle of the forewing. This form is present from January to June. Thus the three forms described above have been classified according to their seasonal occurrence: (1) Monsoon-Autumn form—*Pyrilla aberrans* Kirby,[3] (2) Autumn-Winter form—*Pyrilla pusana* Distant,[1] (3) Winter-spring and summer form of *P. perpusilla* Walker[11-12] respectively.

The study of ♂ genitalia of the three species as made by Pruthi[7] and Quadri and Aziz[8,9] and their separation based on the structures of the anal-tube, ædeagus and parameres do not appear to yield sufficiently definite data for their differentiation, since the characters for distinguishing the three Indian forms appear to be insignificant.

A study of the external morphology of the three forms especially of the ♂ genitalia, was supplemented also by inter-breeding experiments under laboratory conditions in order to obtain confirmatory results. The present authors noted that in nature as well as under laboratory conditions, the rainy season form recognized up till now as *P. aberrans* paired freely with the form occurring during winter months known as *P. pusana*. Moreover, forms occurring during winter were found to breed successfully with the summer form, *viz.*, *P. perpusilla*.

Thus both morphological and breeding experiments conducted in the laboratory are in conformity with the observations made in the field. All these facts lead the authors to conclude that there is only one typical species in existence, *viz.*, *P. perpusilla*, the other two so-called species being only seasonal colour variations or phases. In conclusion, we would consider the systematic position of the three Indian forms existent in India to be as follows: (1) Winter-spring-summer form—*Pyrilla perpusilla* Walker, 1851; (2) Monsoon-autumn form—*P. perpusilla* var. *aberrans* Kirby, 1891; (3) Autumn-winter form—*P. perpusilla* var. *pusana* Distant, 1914.

The authors wish to record their thanks to Dr. E. S. Narayanan for providing the necessary facilities for the work.

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## CHROMOSOME STUDIES ON *RHIPICEPHALUS SANGUINEUS* LATERILLE AND *HYALOMMA AEGYPTIUM* NEWMANN (ACARINA : IXODIDAE)

THERE seems to be a paucity of information regarding the chromosomes of the family Ixodidæ except for a publication by Tuzet and Millot,[1] who worked on the spermiogenesis of *Rhipicephalus bursa* and *Hyalomma œgyptium* and casually stated the chromosome number to be twelve in the primary spermatocyte metaphase of these two genera. Some work has, however, been done on the families Gamasidæ and Argantidæ, where the males seem to be diploid[2,3]; while in the family Tarsonemidæ there is a haplo-diploid system

of sex-determining mechanism as reported by Cooper.[4,5] With a view to investigate the sex-determining mechanism in the family Ixodidæ the present work was undertaken.

Testes from males of *Rhipicephalus sanguineus* Laterille and *Hyalomma ægyptium* Newmann were fixed in medium Flemming both with and without acetic acid and then sectioned at 15 micra in thickness. Slides were stained with Iodine crystal violet.

Spermatogonial divisional stages have been rare in *Rhipicephalus* but not so in *Hyalomma*. The metaphase plates could not, therefore, be studied in the former. In *Hyalomma*, the prophase chromosomes are found to be quite well developed though they are very small in size. The metaphase plates show the chromosome number to be $2n = 21$ (Fig. 1). The autosomes



FIG. 1. Spermatogonial metaphase plate of *Hyalomma*, × 1,700. FIG. 2. Diplotene stage of *Hyalomma*, × 1,270. FIG. 3. Metaphase I stage of *Hyalomma*, × 1,270. FIG. 4. Anaphase I stage of *Hyalomma*, × 1,270. FIG. 5. Late anaphase I state of *Hyalomma*, × 1,270. FIG. 6. Metaphase II stage of *Hyalomma* with the X-chromossome, × 1,700. FIG. 7. Metaphase II stage of *Rhipicephalus* without the X-chromosome, × 1,700. FIG. 8. Metaphase II stage of *Rhipicephalus* with the X-chromosome, × 1,700. FIG. 9. Anaphase II stage of *Rhipicephalus*, × 1,700. FIG. 10. Anaphase II stage of *Hyalomma*, × 1,270.

are all acrocentric while the sex chromosome, which is the largest in the complement, is meta-

centric having the two arms unequal, and show no heteropycnosis.

Chromosome number in *Rhipicephalus* has been determined from the meiotic stages. It is seen that there are ten bivalents and one univalent, the latter representing the sex chromosome, at the various stages of meiosis. The X-chromosome in this genus is also the longest among all the chromosomes and is metacentric in form.

Compared with the size of the cell, the nuclei in both the genera are quite small. The earliest stages in the spermatogonium show two to four deeply stained bodies within the nucleus in the case of *Hyalomma* and one in the case of *Rhipicephalus*. Sharma[6] has recognised these bodies as the nucleoli. At the earliest spermatocyte stage, the X-chromosome is found to be positively heteropycnotic and more or less spherical in form in *Rhipicephalus* and also in *Hyalomma*. The nuclei at this stage also show large number of deeply stained dots in both the genera. At diplotene stage one chiasma per bivalent has been observed in both. Occasionally two chiasmata are also observed in *Hyalomma*. Regarding the terminalization of chiasmata, it has been observed that in both *Hyalomma* and *Rhipicephalus*, there is a significant increase of terminal chiasmata from diplotene to diakinesis and from diakinesis to metaphase. In *Hyalomma*, the X-chromosome has sometimes been observed to be metacentric at diplotene stage in which case the two arms have been found to be unequal (Fig. 2). The two chromatids composing the X-chromosome have been found to be relationally coiled. At metaphase I, the chromosomes are arranged on the equatorial plate with the sex chromosome forming an accessory plate in both the genera (Fig. 3). The centrosome has been clearly observed in *Hyalomma* alone. This structure appears to be very small and spherical and is surrounded by a non-staining portion. During anaphase I, the sex chromosome has been found to be precocious in its movement only in *Hyalomma* (Fig. 4). Occasionally it has been to be lagging on the equatorial plate. In both the genera the first meiotic division being reductional for the X-chromosome (Fig. 5), two types of second division metaphase plates are obtained—one type with the X-chromosome (Figs. 6, 8) and the other without it (Fig. 7). The sex chromosome divides equationally at anaphase II stage in both the genera (Figs. 9, 10).

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mal Genetics, Indian Veterinary Research Institute, Izatnagar, and to Dr. S. P. Ray-Chaudhuri, Department of Zoology, University of Calcutta, for criticism.

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## *PLASMOPARA WILDEMANIANA* P. HENN. VAR. *MACROSPORA* ON A NEW HOST *RUNGIA PARVIFLORA* NEES

THE leaves of *Rungia parviflora* were found to be heavily infected by downy mildew soon after the rains in October 1953 at Bhagalpur. White cottony growths were found on the lower surface of the leaves, the corresponding upper surface exhibited light greenish to brown colouration. Irregular spots were formed on the leaves, gradually increasing in size, resulting in the withering of the leaves.

The mycelium of the fungus is endophytic, colourless and intercellular. Sporangiophores protrude from the stomata either singly or in fascicles. The sporangiophores are monopodially branched ; the branches arise more or less at right angles to the main axis, the secondary branches are also at right angles, the terminal branches are apically obtuse. The sporangiophores are upright, 300-600 $\mu$ long and 7-12 $\mu$ thick with slight swollen base. Sporangia are hyaline, papillate, ovoid, 15-17 $\mu \times$ 11-14 $\mu$. The number of sporangia were very few. Oospores were not seen.

The fungus under study exhibits close affinity in morphological characters to *Plasmopara wildemaniana* P. Henn. var. *macrospora* Sawada[1] (Syn. *Pseudoplasmopara justiciæ* Sawada) on *Justicia procumbens* (*Acanthaceæ*) reported from Formosa and is therefore referred to the same species. The specimen has been deposited in Herb. C.M.I. (Herb. I. M.I. No. 54717).

It is evident from available literature, this is the first record of the fungus on *Rungia parviflora* which is a new host for the fungus.

Grateful thanks are due to Mr. E. W. Mason and Dr. Brown of Commonwealth Mycological Institute, England, for their kind help in identification of the fungus.

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## OCCURRENCE OF GROWTH RINGS ON THE OTOLITHS OF THE INDIAN WHITING, *SILLAGO SIHAMA* (FORSKÅL)

STUDIES on otoliths and scales for determining the age and rate of growth of Indian fishes have been reported only during comparatively recent years. It is well known that the otoliths and scales of several species of fishes in the temperate region possess distinct annular rings. This character has been extensively used in determining the year class composition of fish populations. The fishery worker in the tropical region is at a disadvantage as the otoliths and scales of most tropical fishes do not indicate such clear markings. There are, however, a few instances where growth rings on otoliths and scales have been observed in tropical fishes.[1-4]

During the course of investigations on the biology of the Indian whiting, *Sillago sihama* (Forsk.), very clear growth rings have been observed on the otoliths, and in most cases it is even possible to make out the complete rings with the naked eye. These otoliths, after cleaning, were evenly ground on carborundum with a drop of glycerine, dehydrated in various grades of alcohol, and finally cleared in xylol. The boundary lines between successive zones are well marked in many cases. The rings appear in dark translucent zones, concentric with the margin of the otolith, whereas the intervening zones appear white and opaque. False rings can be easily distinguished from the true rings by the characteristics given by Walford and Mosher[5] for the Californian sardine, *Sardinops cærulea*.

The whiting catches landed along the coast of Rameswaram Island comprise individuals ranging in size from 2-29 cm., the commercial size being 16-23 cm. Observations made during the last 7 months indicate that this species of fish attains sexual maturity at a length of 13-14 cm., when they are perhaps one-year-old.

Examination of this one-year-old fish shows a single ring on the otolith, while those of 16-20, 20-24 and 24-28 cm. size groups reveal distinctly two, three and four rings respectively. The photomicrographs of otoliths reproduced here
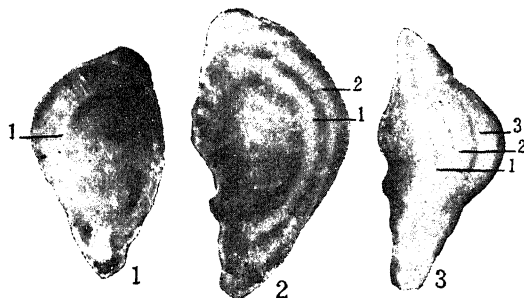


FIG. 1. Otolith of *Sillago sihama* (Forsk.) showing one growth ring. Body length of fish 14·2 cm., caught Oct. 10, 1953.

FIG. 2. Showing two growth rings. Body length of fish 19·5 cm., caught Oct. 28, 1953.

FIG. 3. Showing three growth rings. Body length of the fish 23·3 cm., caught Oct. 6, 1953.

were taken with reflected light and show clearly the first, the second and the third growth rings. There are instances where some of the otoliths failed to show distinct rings at all for reasons not yet clear or conclusive. In most of the cases only the first and the second rings are seen and only in a few examples were the third and fourth rings clearly marked. In this connection the scales of the fish were also examined and some of them show the formation of clear annuli, particularly in the advanced size groups, while in the earlier stages these annuli are not clear.

The results obtained from the length frequency distribution were checked with the growth zones on the otoliths and scales. A well represented mode in the 14-15 cm. size group coincides with the series of specimens which denote one ring on the otolith. The other modes are not clearly marked although there are indications of modes which will be clarified with further data.

It is difficult to explain the exact significance of the formation of rings on the scales and otoliths, but a more critical study is being made particularly in relation to the feeding habits of the fish. It is probable that reduced feeding and the maturation of gonads occurring simultaneously may perhaps play a part in the formation of the growth checks found in the otoliths and scales. Details of the work will be published elsewhere.

My thanks are due to Dr. N. K. Panikkar for his guidance and encouragement.

Central Marine Fisheries     N. RADHAKRISHNAN.
     Research Station,
Mandapam Camp,
*March* 30, 1954.

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## DACTYLISPA ALBOPILOSA GESTRO: A NEW HISPID PEST OF JOWAR (ANDROPOGAN SORGHUM) IN INDIA

DURING the months of August-September 1953, the Jowar plants in the plot of land adjoining the Institute were found to be heavily infested with a type of Hispid beetle, which was later on identified as *Dactylispa albopilosa* Gestro belonging to the superfamily Phytophaga, family Chrysomelidæ.

The species *albopilosa* was first described by Gestro in 1888, from Thagata in Burma (there was no mention of the host plant) and has not, so far, been recorded as a crop pest. This species is being recorded for the first time as a pest of Jowar in India.

The genus *Dactylispa* comprises a large number of species having a wide range of distribution in Ceylon, Sumatra, Dutch East Indies and Tanganyika. They have established themselves as serious pests of various commercially important crops like cinchona, kapok, coffee and maize.

Insects are oblong and about 5 mm. in length, yellowish brown in colour (Fig. 1). Prothorax quadrate, anterior cylindrical region raised into a pair of spines. On either of the lateral sides of the prothorax, there are three spines. The first and the second appendiculate on a common stalk, the second being the longer; the third and outermost spine is free, small and pointed. The apices of all the spines are black. Elytra punctate and striate. Along the scutellar edge of the elytra are four spines, the first and the last of which are longer. On each side, the elytral margin bears fourteen spines, while each elytral surface bears twelve. All the spines, except the minute ones (which are yellowish brown), are black with also a small area round their base.

The adults, as well as the grubs feed on the green matter of leaves. The adults are external feeders and feed by scraping the leaf, while the leaf-mining grubs feed voraciously on the
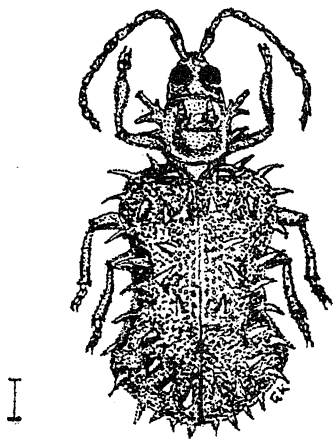


FIG. 1.　*Dactylispa albopilosa*—adult

tissues between the two epidermal layers of the leaf and finally pupate there. The affected portions of the leaf are thus rendered membraneous and transparent making the grubs and the pupæ visible.

The loss of chlorophyll prevents the leaves from carrying out their normal functions, affecting thereby the nutrition and growth of the plant.

The pest can easily be controlled by clipping off the affected leaves and burning them. BHC 5% dust, DDT 5% dust and 50% wettable DDT may be used for the control of the adults.

The authors' thanks are due to the Commonwealth Institute of Entomology for kindly identifying the insect and to Dr. S. N. Banerjee for encouragement and help.

State Agri. Res. Inst.,　　RAJENDRA KUMAR DE.
Tollygunge,　　　　　　　　GOPA KONAR.
Calcutta, *March* 11, 1954.

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## OCCURRENCE OF *OIDIOPSIS TAURICA* (LEV.) SALMON ON A NEW HOST, *RICINUS COMMUNIS* L.

*Oidiopsis taurica* (Lev.) Salmon is a cosmopolitan fungus found on a wide range of hosts, many of which are of minor or no economic importance, except the commonly grown vegetables *Cyamopsis psoraloides* and *Dolichos lablab*. A new variety of *O. taurica* var.

*macrospora* was described by Uppal, Kamat and Patel[1] on the latter.

The author found recently a solitary plant of castor (*Ricinus communis*) in Poona showing a species of *Oidiopsis*. The leaves showed yellowish chlorotic patches on the upper surface, and an overgrowth of the greyish fungus consisting of conidiophores and conidia on the lower.

The fungus is typically endophytic with button-shaped haustoria in the mesophyl cells and sends out tufts of simple conidiophores through the stomata, mainly on the lower side, bearing characteristic barrel-shaped or conical conidia. The conidia measure from $50 \cdot 5$ to $70 \cdot 2 \mu \times 15$-$19 \cdot 5 \mu$, and their shapes were found to tally closely with those typical for *Oidiopsis taurica* from *C. psoraloides* ($47$-$71 \mu \times 10$-$20 \mu$). This fungus is, therefore, determined as *Oidiopsis taurica* (Lev.) Salmon.

The author is grateful to Prof. M. N. Kamat for guidance and to Dr. S. P. Agharkar for facilities offered.

M.A.C.S. Laboratories,　　　P. P. CHIDDARWAR.
Law College Buildings,
Poona-4, *March* 11, 1954.

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## ALIMENTARY CANAL AND ASSOCIATED STRUCTURES OF THE JASSIDAE (HOMOPTERA)

AT present our knowledge of the digestive system of the Jassidæ is confined to *Cicadula sexnotata* (Dobroscky),[1] *Idiocerus clypealis* and *I. niveosparsus* (Quadri),[2] and *Typhlocyba ulmi* (Willis).[3] Quadri denies the presence of 'filter-chamber' in jassids while Dobroscky reports its presence. In *Typhlocyba ulmi*, Willis does not find a true chamber enclosing the apposed extremities of the midgut yet he refers to this part of the gut as the 'filter-chamber region'. The writer extended the study of digestive system to the following jassids:

Subfamily Hecalinæ: *Hecalus lefroyi* Dist., *Parabolocratus porrectus* Walk.; Subfamily Aphrodinæ: *Leofa mysorensis* Dist., *Chiasmus alata* Pruthi, *Gurawa vexillum* Dist.; Subfamily Tettigellinæ: *Tettigella spectra* (Sign.); Subfamily Idiocerinæ: *Idiocerus clypealis* (Leth.); Tribe Euscelini: *Nephotettix apicalis* Motsch.; Tribe Balcluthini: *Eugnathodus indica* Pruthi; Tribe Platymetopiini: *Paternus vertica* Pruthi;

Subfamily Typhlocybinæ : *Empoasca kerri* Pruthi, *E. devastans* Dist., *Empoascanara prima* Dist. and *Typhlocyba gemmata* Dist.

The alimentary canal commences at a short, muscular pharynx which leads into a narrower œsophagus. The latter extends upto the metathorax to open into the midgut which lies in the abdomen disposed in the form of 'U' with its two limbs variously coiled. Three distinct regions can be distinguished in the midgut : an anterior sac-like first ventriculus, a tubular second ventriculus and, a tubular third ventriculus which differs from the preceding region in the presence of numerous minute globules in its lumen. The two extremities of the midgut lie apposed to each other. The third ventriculus is followed by a narrower intestine which proceeds backward to open into a short pear-shaped rectum. Four malpighian tubules open into the midgut a short distance in front of the pyloric valve. Of these, two open separately while the other two open by a short common duct. Each malpighian tubule presents three zones : a proximal narrow, tubular region which is translucent ; a middle wide, whitish opaque region, and a distal short, narrower region.

The alimentary canal and the malpighian tubules present together three different conditions in different jassids examined. (*i*) In the Typhlocybinæ the two apposed extremities of the midgut are not enclosed by any sheath of tissue so that the 'filter-chamber' is absent. The wall of the midgut includes a layer of longitudinal muscle fibres. All the malpighian tubules are joined together at their distal ends so that their lumina are confluent. (*ii*) In the Balcluthini the two apposed extremities of the midgut are enclosed in a common chamber, the 'filter-chamber'. The wall of the midgut is devoid of the longitudinal muscle fibres. The distal ends of the malpighian tubules are joined together, as in the Typhlocybinæ. (*iii*) In the rest of the jassids there is present a distinct 'filter-chamber' whose size differs in different species. The wall of the midgut is devoid of the longitudinal muscle fibres, as in the previous group. Unlike the first two conditions, the malpighian tubules in this case do not join together but they re-associate separately with the rectum and project into its lumen.

The salivary glands also present two conditions in this family. In the Hecalini each principal gland consists of two regions : a small rosette-shaped cluster of acini and an elongate cluster of acini situated beneath the crown along its lateral margins. The two salivary ducts open separately into the salivary syringe.

On the other hand, in the rest of the jassids the principal gland comprises only a small rosette-shaped cluster of acini and the two salivary ducts join together before opening into the syringe.

The taxonomic significance of these characters will be discussed separately.

Dept. of Zoology,       K. N. Saxena.
University of Delhi,
*April* 3, 1954.

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## EFFECT OF EXCESSIVE NITROGENOUS MANURING ON THE LODGING AND YIELDS OF WHEAT

INDIAN soils are mainly deficient in nitrogen which should be applied in optimum amount to obtain high yields. The application of nitrogen in inadequate amounts may impede the exploitation of the variety, while the same in excess may not only be ineffective in affecting the crop growth but may lead to some deleterious effects such as lodging and may reduce the final yields.[1-4] The present paper summarises the response of wheat (Pb. 591) to increasing levels of nitrogen (0, 15, 30, 45, 60, 75, 100 and 105 lb. nitrogen per acre) applied in the form of ammonium sulphate with and without basal dressing of FYM (20 lb. nitrogen per acre) together with the adverse effect of excessive nitrogenous manuring as a result of the lodging of the crop. The experiment was conducted during the year 1950-51 at the B. R. College Experimental Farm, Bichpuri (Agra). The soil was light loam in texture and of average fertility.

The experiment was conducted in single split plot design with four replications taking basal and no basal dressing as the main treatment. FYM was applied one month before and ammonium sulphate one day before the sowing of wheat by broadcasting on the soil surface and mixing by ploughing.

The grain and bhusa yields obtained under different treatments are given in Table I.

The grain yield increased with increasing levels of nitrogen upto 60 lb. N per acre and decreased thereafter under higher levels than this while the bhusa yield increased with increasing levels throughout. The application of nitrogen at each level increased both the grain and bhusa yields significantly over control.

### TABLE I

*Grain and bhusa yields (md./acre) under different levels of nitrogen*

| Levels of nitrogen | Grain yield | Bhusa yield |
|---|---|---|
| 0 | 14·31 | 28·57 |
| 15 | 17·17 | 37·33 |
| 30 | 19·14 | 41·16 |
| 45 | 22·51 | 48·15 |
| 60 | 23·49 | 51·36 |
| 75 | 22·39 | 54·24 |
| 100 | 22·22 | 54·59 |
| 105 | 22·04 | 55·56 |
| C.D. @ 5% | 2·61 | 6·23 |
| C.D. @ 1% | 3·51 | 8·34 |

The crop lodged a fortnight after the completion of ear emergence under 75, 100 and 105 lb. nitrogen per acre. The observations were taken on the extent of lodging and its effect on the bhusa and grain yields under the respective levels of nitrogen. Under the levels of nitrogen that induced lodging, the expected yields of both grain and bhusa that might have been obtained, if there had been no lodging, have also been calculated.

### TABLE II

*Extent of lodging and its effects on acre yields*

| Treatments | Percentage of total area lodged | Reduction in acre yields in percentages — Grain yield | Reduction in acre yields in percentages — Bhusa yield | Expected yield (Md./acre) — Grain yield | Expected yield (Md./acre) — Bhusa yield |
|---|---|---|---|---|---|
| 75 lb. N/acre | 27·12 | 46·36 | 33·19 | 25·50 | 62·24 |
| 100 ,, ,, | 31·12 | 51·29 | 32·95 | 25·80 | 64·24 |
| 105 , ,, | 40·00 | 50·00 | 34·42 | 27·43 | 66·32 |
| Basal dressing of F.Y.M. | 31·20 | | | | |
| No Basal dressing | 34·30 | | | | |

The percentage of area lodged increased with increasing levels of nitrogen, unlike inorganic nitrogen the application of basal dressing reduced the lodging. On an average the lodging reduced the grain and bhusa yield by 49·21 per cent. and 33·52 per cent. respectively. The expected yields under different levels of nitrogen indicate that the yields of both grain and bhusa would have increased with increasing levels of nitrogen even upto 105 lb. nitrogen per acre, had there been no lodging at all.

Thus it is clear from the results that excessive nitrogenous manuring is responsible for an appreciable reduction in both the grain and bhusa yields by causing the wheat crop to lodge. Therefore, under the conditions tried in the experiment the dose of nitrogen beyond 60 lb. per acre should not be applied to wheat crop as it means a double disadvantage, i.e., a loss of valuable fertilizer on the one hand and the reduction in the yield on the other.

Dept. of Agronomy,      RANVIR SINGH.
B. R. College, Agra,
*February* 10, 1954.

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# REVIEWS

**Analysis of Deformation, Vol. I.** By Keith Swainger. (Chapman & Hall), 1954. Pp. xix + 285. Price 63 *sh*.

Analysis of deformation, both elastic and plastic, has fascinated many mathematicians, engineers and physicists. Small deformations give rise to elegant mathematical theories like that of elasticity and slow viscous flow. The theory of finite deformation has been used to explain a number of experimental results like axial stresses produced in a cylinder subjected to finite twist. It has been the subject of a number of recent investigations. In 1935 a paper by B. R. Seth (*Phil. Trans. Roy. Soc.*, 234, 231-264) marked the beginning of a series of papers on this subject by F. D. Murnaghan, R. S. Rivlin, D. Panov, P. M. Riz, N. Zovlinsky, C. Truesdell and others. In it the idea was stressed that for technical applications finite components of strain should be referred to the deformed framework. The keypoint in the present book is also the same. The author defines the true normal strain as $e = (l - l_0)/l$, $l$ and $l_0$ being the stretched and unstretched lengths. On the basis of a linear stress-strain relation it gives $T = E(l - l_0)/l = E[1 - (1 + s)^{-1}]$, $s$ being the ordinary stretch. The tension stretch curve is now not a straight line.

When referred to spatially fixed axes in the deformed framework the strain tensor has second degree terms in the gradient of the deformation and is given by

$$\epsilon_{ij} = (u_{i,j} + u_{j,i}) - u_{k,i} u_{k,j},$$

comma denoting covariant differentiation. Using the method of dyadics the author wants to make out that the second degree terms are not necessary if the deformation is referred to locally convected axes. In such a case the equations become linear if the stress-strain tensor relation is assumed to be linear. For plastic problems this is bound to give good results. This point the author has made out in a number of papers. For elastic problems his ideas have been subjected to criticism by C. Truesdell, R. S. Rivlin and others. The author in turn criticizes Rivlin's postulate that a rotation of a line element through 180° changes the sign of the scalar stretch ratio. He also points out that Rivlin's confusion of scalar and vector effects is responsible for his criticism of Seth's method.

In mathematical language the author's exposition refers to the fact that in a deformed body any further small strains referred to the strained framework are tensorial in character, and hence no non-linear terms may be taken in the finite strain components. From the applicational point of view the spatially fixed frame is important, and it is not clear how the locally convected axes will help to solve technical problems. The author has reserved applications for Vol. II of his work and all concerned will await its publication.

Vector and dyadic methods are used throughout the book. It has nine chapters dealing with displacement, stress, strain, stress-strain relations, thermal effects, yield and elastic, visco-elastic, elasto-plastic isotropic substances. There are three appendices on vectors, scalars and potential theory. A list of references is given but there are no references to Russian work. Even Novozhilov's "Foundations of the non-linear theory of elasticity" is not listed. A glossary is a valuable addition to the book which is very well got up. On p. 175, the initials of Murnaghan should be changed from F. T. to F. D. The semi-colon used for partial differentiation in the book should be understood to imply covariant differentiation if the formulæ are to be used in the curvilinear orthogonal system. All interested in the development of continuum mechanics will find the book excellent reading.

B. R. Seth.

**Tables of Barometric Pressures at Varying Temperatures.** By J. D. W. Ball. (Constable & Co.), 1953. Pp. 23. Price 5 *sh*.

The Tables contain equivalents of barometric pressure measured in millibars or inches of mercury, expressed in terms of kilogrammes per square centimetre, pounds per square inch and pounds per square foot. Conversions of kilogrammes per square centimetre into bars at standard gravity and Greenwich gravity are also given. A limited range of pressure from 720-800 mm. of mercury at temperatures from 0-40° C. is covered. The Tables would be useful to technical workers interested in this restricted range of pressures and temperatues.

In pages 10-16, inches of mercury are expressed as 28·5, 28·55, 29·5, 29·65, etc., the

second decimal being omitted when it is zero. The retention of zero in the second decimal place would have helped in making the values unambiguous. The get-up is good and the publication is neat and handy.   P. KOTESWARAN.

### Characteristics and Applications of Resistance Strain Gages   (*Proceedings* of Symposium held November 8 and 9, 1951.) (NBS Circular 528.) (Order from Govt. Printing Office, Washington 25, D.C.)   Pp. 140.   Figs. 143. Tables 15. Buckram Bound. Price $ 1.50.

The papers presented at this symposium represent some of the latest results, both experimental and theoretical, in the study of resistance strain gages by many leading institutions in the United States and abroad.

Papers presented at the symposium covered these applications and also reported new work in progress on strain gages consisting of a conducting coating applied by an evaporation technique, on special temperature compensated gages, on gages for strain measurements well beyond the elastic range, and on the application of strain gages to the determination of dynamic properties of materials and to the measurement of very large static forces. Eleven papers are reported in the volume along with transcriptions of the discussions that followed.

### Abnormal Oscillations in Electric Circuits Containing Capacitance. By Niels H. Knudsen. (Number 69 of Transactions of the Royal Institute of Technology, Stockholm, Sweden), 1953.   Price Kr. 12.

The monograph is in three parts.   The first part gives a resumé of the history of the phenomenon and the work done so far by different workers in this field. The author discusses the oscillations under two groups, dealt with in Parts II and III.   (*a*)   Ferro-magnetically generated oscillations covering subharmonics, jump phenomena at supply or dynamic frequency and ultraharmonics ; and (*b*) Machine-generated oscillations covering self-excitation of synchronous and asynchronous machines. The phenomena of oscillations in some cases may be of a parasitic nature, in which cases these are regarded as disturbances and the main interest is concentrated upon the question of how to avoid them. In some cases, it is also of interest to know the amplitude the oscillations will attain because of abnormal circuit conditions.

In Part II, Ferromagnetic resonance oscillations are described. The selection of a proper

analytical expression for the magnetization curve of the inductor to enable one to carry out the analysis of the ferro-resonance phenomena and equivalent circuits to represent in performance the behaviour of ideal and non-ideal inductors are discussed in detail. Three sections in this part are devoted to resonance at subharmonic, supply and higher harmonic frequencies.   In each case, the theory of the method of calculation is developed and experimental results obtained earlier by other workers are discussed in the light of the theory developed.

Part III deals with the problem of self-excitation of induction and synchronous machines. In each case the general theory is developed and the principal question, which concerns the character of natural oscillations, is dealt with by examining the roots of the characteristic equation belonging to the system.   The applications of the theory to a number of practical cases of different kinds are discussed. Finally, brief mention is made of theoretical and experimental investigations made in Sweden.

An exhaustive bibliography of available literature in the subject is given.   The monograph will be of special interest and help to those concerned with the problem of power system operation with reference to disturbances met with due to abnormal oscillations.

C. S. GHOSH.

### (*i*) A New Theory of Sheet Movements and Continental Expansion.   (*ii*)   The Gondwana Formations of India and the Nature of Gondwanaland.   (*Memoirs* 1 *and* 2).   By K. P. Rode.   Department of Geology, Rajputana University.

In the first of these memoirs, covering about 30 pages, Dr. Rode has ventured to tackle one of the fundamental and controversial problems in geology, *viz.*, the origin and distribution of continents and oceans—a problem which has engaged the attention of eminent geologists for more than a hundred years now, and in the study of which the name of Alfred Wegener, among recent workers, is so prominently associated.   After noting certain observations from the tectonic and stratigraphic history of India and Africa, and interpreting them in his own way, Dr. Rode tries to derive support to his new theory of 'Sheet Movements and Continental Expansion'.   The author admits that the theory, as now enunciated 'is still in its outline form, and needs much study to work out the details and its implications'; he nevertheless claims that it is essentially 'sound' and 'will

explain satisfactorily the numerous problems in geology which still defy solution'. It is, according to the author, 'a theory of universal application and seeks to develop a universal *modus operandi*, the exact nature of which is yet to be fully understood'.

In the second paper, Dr. Rode deals with the Gondwana formations of India and their comparison with similar formations in other Continents and on the basis of these studies a new idea of Gondwana land has been put forward. According to this, 'initially the various coal-bearing Gondwana formations in S. Hemisphere might all have been quite closely spaced, contiguous, or even partly overlapping, and that it was only in the post-Deccan Trap period that the various continental sheets bearing Gondwana sediments separated and spread out to their present positions', by a process of 'horizontal slicing of the Gondwana basin and movement of sheets either laterally or radially over long distances', as visualised by the author in his general theory of 'Sheet Movements and Continental Expansion' propounded in the first memoir.

It is hardly possible in the course of a short review like this to adjudge the merits of Dr. Rode's theory,—all the more so when it is presented in such a brief and summary manner. It is hoped that the author will soon come out, in justice to himself, with a fuller and more substantiated version of his theory, which will help us to understand and follow his arguments more clearly, and thus enable fruitful discussion.

**Spot Tests**, Vol. I. (*Inorganic Applications.*) By Fritz Feigl. Translated by Ralph E. Oesper. (Elsevier Publishing Co.), 1954. Pp. xii + 518. Price 45 *sh.*

This book presents in a very readable manner the merits and the applicability of the spot test technique in qualitative as well as quantitative inorganic analysis.

The first two chapters expound the beginnings and development of spot tests and also give a clear account of the equipment and procedures employed for their application.

The third chapter deals with tests for metals and this is subdivided into four parts dealing respectively with (*a*) basic and acid sulphide groups, (*b*) ammonium sulphide group, (*c*) ammonium carbonate group, and (*d*) alkali metals and ammonia and its derivatives. The fourth chapter describes the tests for anions, while the fifth is concerned with general and specific tests for free metals, alloys and also

free non-metals. Chapter six presents some tested schemes for the systematic analysis of mixtures by spot reactions while Chapter seven gives some important applications of spot reactions in tests of purity, examination of technically important materials and studies of minerals. The concluding chapter is devoted to a summary in tabular form of the limits of identification attainable in spot tests.

The characteristics of the several tests for the various ions such as limit of identification and dilution limit are given in each case. The tests which have been thoroughly tested by the author are described in detail. The procedure for the test as well as the preparation of test and reagent solutions are clearly indicated. It is therefore possible to select the most appropriate reagent and procedure for the substance to be tested. The book includes several tests developed by the author which have not yet been published elsewhere.

This book by Prof. Feigl, who has made the most outstanding contributions to the development of spot tests, is a very noteworthy publication and will be of much assistance to all engaged in work of a chemical nature. The printing and get-up are excellent.

K. R. K.

**Chromatography.** (*A Review of Principles and Applications.*) By E. Lederer and M. Lederer. (Elsevier Publishing Co.), 1953. Pp. xviii + 460. Price 60 *sh.*

Chromatography as an analytical tool has been used quite extensively during the last decade for the separation and purification of organic and inorganic substances. Several monographs have already been published on the subject and extensive reviews have also been written on one or more aspects of chromatography.

The book under review has, however, certain unique features which makes it a welcome addition to the existing publications. The authors have in this volume discussed under three broad divisions of adsorption chromatography, ion exchange chromatography and partition chromatography the principles and the different kinds of equipment employed, and then proceed to give in very great detail, the separation by chromatographic technique of organic and inorganic substances. It is perhaps in the division of chromatography of inorganic substances, especially in the chapter on inorganic paper chromatography, that the book excels, and appears to be the most authoritative and exhaustive treatment of that particular subject. Further, the book contains valuable informa-

tion about all types of equipment used in different kinds of chromatography. Extensive references are included in the text and references appearing in the literature after July 1952 have been given chapterwise towards the end of the book.

It is obvious that considerations of brevity have induced the authors to write thus on p. 118 : 'Examples of successful purification of hydroxylated and unsaturated lactones may be found in 651, 652, 653, 1394, 1935' and on p. 151 : 'For the isolation of optically active mepacrine by direct chromatography of urine, see (643)'. Also it is felt that '*et al.*' and '*coll.*' have been used without adopting uniform terminology for such common expressions. But these are just minor points only, which will no doubt be attended to in a future edition.

The volume is amply illustrated with excellent diagrams and photographs, including a few which are coloured reproductions and the tabulated data giving characteristics like Rf values under well defined conditions for many organic and inorganic substances. The book should therefore prove to be extremely useful to all those who are interested in acquainting themselves with the different techniques and applications of either adsorption or ion exchange or paper chromatography.

P. S. SARMA.

**Chemistry of Carbon Compounds, Vol. II B.** (*Alicyclic Compounds*). Edited by E. H. Rodd. (Elsevier Publishing Co.), 1953. Pp. 489-1092. Price £ 5-5-0.

Volume II A of the series described systematically the simpler type of compounds of alicyclic nature and was reviewed earlier in this Journal. Volume II B deals with substances of increasing complexity found largely in plant and animal kingdoms.

The first half of the book (Ch. 12-16) concerns the chemistry of terpenoids and is written by D. H. R. Barton with certain portions by S. H. Harper. The second half (Ch. 17, 18 and 19) relating to the steroids is under the authorship of C. W. Shoppee and Eileen Shoppee. These authors have been intimately connected with the chemistry of these groups and hence the treatment is authoritative and modern. Most of the subject-matter of this volume is of current interest. Actually, the systematic study of sesquiterpenes began from 1920 and those of di- and tri-terpenes later than 1930. It is well known that the chemistry of steroids assumed great importance only during the past 20 years. The elucidation of

structure and later the synthetic work constitute one of the most brilliant chemical achievements of the second half of this century. Many of these substances belong to physiologically active groups. Not only are they of complex structure but involve stereochemical problems of great interest. In Chapter 13 a clear and concise treatment of the Wagner-Meerwein and Nametkin Rearrangements is given. Under steroids are included such important groups as sterols and bile acids, sex-hormones and adrenocortical hormones and finally cardiotonic glycosides and aglycones, toad poisons, saponins and sapogenins. Though in keeping with the general plan of the series the account has been kept concise, it is extremely clear. There is no doubt that this volume provides very useful reading and reference material for all students of organic chemistry in regard to the highly important sections dealt with.

T. R. SESHADRI.

**Detergency Evaluation and Testing.** (Interscience Publishers Manual 4). By J. C. Harris. (Interscience Publishers, Inc.). Pp. x + 210. Price $ 3.75.

"Detergent", which a few decades back, was a word in the dictionary of pedants to designate soap, today encompasses a much wider range of commercial chemicals, while newer and newer cleansing compositions are continuously invading the market. The larger their number and variety, the greater is the problem of choice of suitable composition for any specific use. Just at present when the question of suitable evaluation procedures for correct choice of detergents is of paramount importance, Mr. Harris must be congratulated for bringing out a collective compendium on the subject of "Evaluation and Testing of Detergents".

The book has been divided into 9 chapters including the introduction and deals with topics like screening tests, washing procedures for fibres like cotton, wool and others and tests for the same, hard surface cleaning, etc. Chapter VIII deals with radio isotopic tracer method of testing which is a highly interesting and potentially powerful method though still in its initial stage. The author has presented a few select surface-active agents with their trade names, their percent activity, physical or commercial form, and chemical constitution in Table I. Each chapter is supplemented with an adequate bibliography giving references mostly to recent publications.

The author has taken particular care to do full justice to the experimental details, and the book contains 25 plates including diagrams and photos of equipment used in testing procedures, so that it can be confidently be recommended as a reference work to those who deal with detergents.

The book is written in a lucid language, and has been got up neatly and nicely on glazed paper.          P. B. JANARDHANAN.

**A Colored Atlas of Some Vertebrates from Ceylon,** Vol. II. (*Tetrapod reptilia.*) By P. E. P. Deraniyagala. (Ceylon National Museums Publication: The Ceylon Government Press), 1953. Pp. 101. Plates 35. Text-figures 44.

The second volume of the *Atlas* fully maintains the high standard which the author had set for himself in the first volume dealing with an account of the "Fishes of Ceylon" (*Curr. Sci.*, 1952, 21, 147). The author, besides giving a systematic account of 9 testudinates (5 marine), 2 crocodiles, 23 geckes, 12 agamids, 1 chamæleon, 25 skinks, 1 lacertid and 2 varanids, has illustrated the various species by a large number of drawings, coloured and black and white prepared by himself which make the identification of the animals easy even for an amateur naturalist. The value of the work is further enhanced by the fact that ecological and biological data concerning the species are also given, mostly based on the field and laboratory observations of the author himself. The reviewer is particularly happy to find in a work of this nature notes on zoogeography, climatic fluctuations, species fluctuations and economics. Though these subjects are treated very briefly, it is clearly shown that a modern systematist does not confine his attention to the preserved specimens in museum but takes into consideration the animals and the environments in which they live.

Under zoogeography, a critical examination of the writer's Satpura hypothesis would have been very appropriate. However, on p. 52, the author makes an important statement when he says, "The *Agamidœ* apparently entered Ceylon in three separate waves". These waves of migration must have come from Peninsular India. According to Ripley (*Evolution,* 1949, 3, 150-59), birds also came to Peninsular India from south-east Asia in three separate waves. Silas [*Proc. Nat. Inst. Sci. India,* 1952, 18 (5), 423-48], has also shown that some of the freshwater fishes entered Peninsular India from the north-east in a series of waves corresponding to the Pleistocene Glacial Periods. It would thus appear that a proper synthesis of the facts concerning animal distribution in South India and Ceylon could now be a very fruitful line of investigation.

The reviewer is not satisfied with the maps of Ceylon. It could have been easily made much larger so that the various ecological associations and letterings could be shown more legibly. The delimitation of the boundaries of the various provinces, so frequently referred to in the text, would have enhanced the usefulness of the map.

The author, the Ceylon National Museums and the Government of Ceylon are to be congratulated on the publication of such a high class work which is sure to stimulate thought and guide further researches into the interesting and specialised insular fauna of Ceylon. The *Atlas* is equally useful for the students of Indian fauna, particularly for those interested in the animal life of Peninsular India. The get-up of the volume is good and the Ceylon Government Press is to be thanked for it.
          S. L. HORA.

**Timber, Its Structure and Properties.** Third Revised Edition. By H. E. Desch. (Macmillan & Co., Ltd.), 1953. Pp. 1224 + 350. Price 25 *sh.*

The third edition of Desch's book on timber is most welcome. It was first published in 1938. The second edition was done in 1947. In the present edition he has added considerably large material to bring it up-to-date and to make it more useful to readers. "Classification of Trees" and "Nomenclature of Timbers" have been re-written with a view to make the subjects clear. The nomenclature of timbers is a difficult subject and still remains to be solved. The author has, however, clearly indicated the present position. Chapters in Part III have been re-arranged. Again, the chapter on "Defects in Timber" has been-dealt with separately and now includes natural defects and seasoning degradation. "The Eradication of Fungal and Insect Attack" forms a separate chapter. Under "Grading of Timber", the author has first dealt with the general principles involved in grading. He then gives some information on the trade practice in the countries of Baltic Sea, of America and of the Commonwealth. Finally, he deals with "Wood as an Engineering Material" wherein "Timber Connectors" and "Adhesives" are discussed.

The present edition includes some additional plates with nice photomicrographs. It must be said here that the students using this book may

not find all the information they want, because from the fundamental point of view this book does not cover a very wide field. In fact it will serve better for the practical men than for the student of wood anatomy. Under the heading "Storage Tissue", wood parenchyma cells have been dealt with. The diagrammatic classification given here may serve for elementary students of wood anatomy, but as far as the reviewer knows there is no foundation for such a classification.

On the whole, the book is a valuable addition to our literature on timber technology. The author should be congratulated for producing such a book.  K. A. CHOWDHURY.

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## Books Received

*Fish Culture in Indonesia.* Edited by A. E. Hofstede, R. O. Ardiwinata and F. Botke. (IPFC, Special Publications), 1953. Pp. xii + 129.

*Organised Industries of India*—Cement. By S. L. Sharma. (The Universal Publishers, Ltd., Hazratganj, Lucknow), 1954. Pp. 70. Price Re. 1.

*Grahasarani Planetary Tables,* Vol. I. (Tables for Mercury). By Harihar P. Bhatt. (Gujarat Vidya Sabha, Ahmedabad), 1953. Pp. viii + 20 + 18. Price Rs. 2.

*The Insulation of Electrical Equipment.* Edited by W. Jackson. (Chapman & Hall), 1954. Pp. ix + 340. Price 42 *sh.*

*Indo-Pacific Fisheries Council Proceedings.* Section II. (IPFC Secretariat, FAO Regional Office, Bangkok), 1953. Pp. 103-276.

*A Text-Book of Radar.* Second Edition. Edited by E. G. Bowen. (Cambridge University Press), 1954. Pp. xiii + 617. Price 45 *sh.*

*The Amplification and Distribution of Sound.* Third Edition Revised. By A. E. Greenless. (Chapman & Hall), 1954. Pp. x + 300. Price 35 *sh.*

*Characteristics and Applications of Resistance Strain Gages.* (NBS Circular 528, Washington-25), 1954. Pp. 140. Price $1.50.

*Energy Transfer in Hot Gases.* (National Bureau of Standards, Washington-25), 1954. Pp. 126. Price $1.50.

*The Properties of Tin.* (Tin Research Institute Fraser Road, Greenford, Middlesex, England), March 1954.

*Recent Advances in Chemotherapy,* Vol. III. By F. C. O. Valentine and R. A. Shooter. (J. & A Churchill, Ltd., London, W.1), 1954. Pp. viii + 292. Price 27 *sh.* 6 *d.*

*Tables of Lagrangian Coefficients of Sexagesimal Interpolation.* (NBS Applied Mathematics Series 35.) (Office of the Scientific Publications, Washington-25, D.C.). Pp. 157. Price $2.00.

*Organic Peroxides.* By A. V. Tobolsky and R. B. Mesrobian. (Interscience Publishers, Inc.), 1954. Pp. x + 197. Price $5.75.

*Methods of Biochemical Analysis,* Vol. I. Edited by David Glick. (Interscience Publishers, Inc.), 1954. Pp. x + 521. Price $9.50.

*Vapor Pressure of Organic Compounds.* By T. Earl Jordan. (Interscience Publishers, Inc.), 1954. Pp. ix + 266. Price $14.50.

*Feigl Spot Tests,* Vol. II. (*Organic Applications.*) By Fritz Feigl. (Elsevier Publishing Co.), 1954. Pp. xv + 436. Price 37 *sh.* 6 *d.*

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## PROFESSOR M. N. SAHA*

THE Meghnad Saha Sixtieth Birthday Committee deserve to be congratulated for the well-authenticated volume they have brought out on the life, work and philosophy of the eminent scientist. After a couple of chapters devoted to his early childhood and student days, the next fifteen chapters give a very readable account of Professor Saha's contribution as a scientist of inernational fame, as well as a teacher and *guru,* to those who came for study and guidance under him. The last eight chapters serve to emphasise the disinterested public worker, which has often led him into the political field. The volume contains a good number of ex-

cellently produced photographs. Besides messages of appreciation received from distinguished scientists all over the world on the occasion of his sixtieth birthday, there are also two articles on Prof. Saha from Dr. J. C. Ghosh and Prof. N. R. Sen, which have a special value as coming from old school fellows of his. A complete list of original scientific papers and special articles published by Professor Saha, is also included.

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* *Professor Meghnad Saha—His Life, Work and Philosophy.* Published by Meghnad Saha Sixtieth Birthday Committee, 1954, pp. 175, Price Rs. 5.

# SCIENCE NOTES AND NEWS

### Breaking the Dormancy in Seeds of Turmeric (*Curcuma longa*)

Sri B. Misro, Central Rice Research Institute, Cuttack 4, writes as follows:

Turmeric seeds were soaked for 10 minutes in 50 per cent. $H_2SO_4$ in a beaker, the acid being stirred constantly. The seeds were separated by filtration and thoroughly washed with distilled water to remove any traces of the acid and transferred to a petri dish containing moist blotting paper. The material was washed daily with distilled water to remove any fungus growth. After 10 days the symptoms of germination appeared in a proportion of the seeds and within a further lapse of 7 days, there was 90 per cent. germination.

### Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work on medical and allied subjects in recognised institutions situated in the Union of India. Applicants should have an M.B., B.S., or M.Sc. Degree or its equivalent, or not less than two years' experience in research work after B.Sc.

Applications in the prescribed form, which may be obtained from the Secretary and Treasurer, should be forwarded through the Guides under whom research work will be carried out and the Heads of the Institutions, and should reach the Secretary and Treasurer, Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay-18, before September 1, 1954.

### Wind Energy

The Fourth Session of the Advisory Committee on Arid Zone Research recommended that qualified experts be commissioned to prepare reports reviewing research carried out on energy sources and use as it pertains to arid and semi-arid regions. At the request of the UNESCO, the Secretariat of the World Meteorological Organization has undertaken to prepare the above reports. These reports are conceived as providing the background of facts and figures concerning wind regimes at heights appropriate for utilization of wind machines in the different arid areas mentioned above. Reports already submitted on the design of wind machines and on the economic and practical aspects of utilizing wind energy in arid areas need to be related to the existence of suitable wind regimes and sites. The reports will constitute background material for the symposium on wind and solar energy which is being jointly organized by the Government of India and UNESCO and which will be held in the autumn of this year.

### Cortisone and Aspirin

A Joint Committee of the Medical Research Council and the Nuffield Foundation, under the Chairmanship of Sir Henry Cohen, has reported that as a result of a trial of the treatment of patients in the early stages of rheumatoid arthritis, there appears to be surprisingly little to choose between cortisone and aspirin. The trial, reported in recent issue of the *British Medical Journal*, concerned 61 patients who had the disease not less than three months and not more than nine. But, it must be emphasized that the report deals with a limited type of patient with the disease in the early stages. For those with many years of incapacity, prolonged treatment with cortisone has been shown to be valuable. It will, however, be necessary in the light of the present results to review the whole position of aspirin in the treatment of the disease.

### Zeitschrift für Physikalische Chemie, New Series

The first issues of the Frankfurt edition of *Zeitschrift für Physikalische Chemie, Neue Folge* are now available. The new series is in continuation of *Zeitschrift für Physikalische Chemie* (appearing since 1887), now being published by Akademische Verlagsgesellschaft, by arrangement with the original owners and in co-operation with Professors K. F. Bonhoeffer, Th. Förster, W. Jost, Georg-Maria Schwab, former editors of the previous series.

Every effort will be made to restore this periodical to its previous international reputation. An International Advisory Board of leading physico-chemists is now being formed.

During 1954, two volumes of *Zeitschrift für Physikalische Chemie, Neue Folge* (New Series), will be published. Orders for and inquiries about these volumes, each priced at $ 8.35, should be addressed to Akademische

Verlagsgesellschaft, m.b.H., Holbeinstrasse 25-27, Frankfurt am Main, Germany.

*Annals of Library Science*

We welcome the opening number of the *Annals of Library Science* which has been recently issued under the distinguished editorship of Dr. S. R. Ranganathan. The contents of the number are: Depth classification, Abstract classification and Demonstration, by S. R. Ranganathan, Critique of UDC and Library Science, by Faqir Chand, Dialectics of UDC, by K. A. Issac, Glossary of Cataloguing Terms, by K. D. Puranic, Library Development Plan for Delhi State, by S. R. Ranganathan and Training for Library Service in Sweden, by G. Ottervik and Moehlenbrock. Further particulars can be had from: The Editor, C 6, Maurice Nagar, University of Delhi, Delhi-8.

*Vegetation Types of India*

A symposium on the vegetation types of India will be held by the Indian Botanical Society on December 31, 1954, and the following days at Baroda. Workers in the field are requested to send their manuscripts together with brief abstracts so as to reach Shri R. Misra, Convener, Department of Botany, University of Saugar, Sagar, M.P., before September 1, 1954. The contributed papers and the proceedings of the symposium will be published at an early date. It is expected to cover the following types of vegetation of the different regions of the country:—forests, grasslands, aquatic vegetation, mangrove, desert vegetation, vegetation of other habitats such as sand dunes, silted banks, eroded and barren areas, etc. The ecological accounts will be given under the following headings—climate, geology and soils, biotic features, floristic composition, succession, climaxes, etc.

*Norwegian Technical Aid to India*

The Norwegian Parliament has voted another £ 500,000 to finance the Norwegian technical aid project in India. Altogether, Parliament has now voted £ 1,500,000 for this project and another £ 200,000 has been raised by a national collection throughout Norway.

*Indian Dairy Science Association—Officers for 1954*

*President*: Sardar Bahadur Sir Datar Singh; *Vice-Presidents*: Dr. K. C. Sen, Sri. P. N. Nanda; *Joint Secretaries*: Sri. M. K. Sastri, Dr. S. C. Ray; *Treasurer*: Dr. Noshir N. Dastur.

## CORRECTION

Vol. 23, No. 3, p. 94: Note on "Use of Growth Substances in the Induction of Parthenocarpy in *Lycopersicum esculentum* and *Capsicum annuum*: In column 2, line 5, *read* 1 p.p.m. *for* 10 p.p.m.

Vol. 23, No. 3, p. 105: Review of "An Introduction to Electronics for Physiological Workers": In column 1, *read* Macmillan & Co., Ltd. *for* Macwilliam & Co., Ltd.

## FORTHCOMING INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCES

| Date | Subject of Conference | Further particulars from | Location |
| --- | --- | --- | --- |
| July 25–August 8 | World Power Conference—Section Meeting (Special Energy Problems of the Tropical and Sub-Tropical Countries) | Dr. Ciro Roman Farina, Rua Visconde de Inhauma 134–15° Rio de Janeiro, Brazil | Rio de Janeiro |
| August 23–28 | World Congress on the Philosophy of Science | Professor Gonseth, Polytechnicum, Zurich, Switzerland | Zurich |
| August 23–Sept. 4 | International Scientific Radio Union—11th General Assembly | M. Ing. E. Herbays, 42 Rue des Minimes, Brussels | Amsterdam |
| August 25–Sept. 1 | Symposium on Analytical Chemistry | Dr. J. W. Robinson, Post Office Engineering Dept., Birmingham 5 | Birmingham |
| August 30–Sept. 9 | International Mathematical Union—2nd General Assembly | Prof. E. Bompiani, Instituto Matematico, Citta Universitaria, Rome | The Hague and Amsterdam |
| September 1–8 | International Cytological Congress | Prof. P. G. Gaillard, Histologisch Laboratorium, Rijksuniversiteit Leiden, Netherlands | Leiden, Netherlands |
| September 11–19 | International Congress of Industrial Chemistry | M. Guilmot, 32 rue Joseph II, Bruxelles, Belgium | Brussels |

## RESEARCH ON HUMAN RELATIONS IN INDUSTRY

GOOD human relations are as important for an industry as efficient machines and production methods. Although the need for making the best possible use of the man power in a factory had been realized for a long time, a proper scientific study of human relations in industry is only of recent origin.

In the eyes of an industrial sociologist, the factory is a social system in itself, with a network of relationships between individuals and groups. The most superficial analysis reveals that these relationships are far more complex than the traditional management-worker antithesis would seem to suggest. Although it may be possible to single out one or more aspects of the relationships for study, all are interdependent to some extent; and it is the recognition of this interdependence which is leading sociologists increasingly to insist that any particular problem of relationships within an organisation must be studied and resolved in terms of the totality of which it forms a part. The interested reader is reffered to two excellent articles on the subject by Dr. W. H. Scott in two issues of *Journal of the Institute of Personnel Management.* (1952, **34**, Nos. 319 and 321).

After considering the difficulties confronting those who wish to investigate social relationships in industry, Dr. Scott discusses some of the contributions of current systematic studies in this field. Social scientists are concerned to discover the conditions under which high productivity and high morale are most likely to co-exist, since under such conditions the satisfaction of the needs of both the individual and the organisation will be at its greatest. Evidence is increasing that fuller opportunities for self-development and a greater measure of self-determination in industry are the basic prerequisites. There is a pressing need for the development of leadership ability and skills at all levels-permissive or consultative, rather than authoritarian, in character.

In a formal organisation, the division of functions among persons or groups of persons and the relationships deemed necessary for their co-ordination are very rigid. But it never quite works in the manner prescribed, owing to the growth of informal relationships which cut across formal lines at all levels. It would be erroneous to regard this informal organisation as unstable or haphazard, for it usually

follows a very definite and persistent pattern, and like all stable relationships, develops characteristic values, norms, beliefs and attitudes which tend to become rooted and resistant to change, and to be binding on the members of the group. In a real sense, therefore, the informal organisation is the one which matters. In conclusion, Dr. Scott suggests that the more the formal and informal organizations can be brought into harmony, the more likelihood there is of achieving a system of social relationships which will be effective both in satisfying individual needs and in attaining common goals.

While the above would indicate the broad outlines of the subject at the research level, it is very encouraging to find that the matter is also receiving adequate attention from quarters which are ultimately responsible for furthering such research projects. In fact, the first report of the Joint Committee on Human Relations in Industry, England, has just been published*. The report includes details of research projects that have been approved and which are now going ahead.

Merely improving conditions of work has not been the first concern of the Committee. The programme of work has been fully discussed with trade unionists and industrialists so that it should be as practical as possible. In every case the Committee has tried to take a broad view of productivity needs because, it believes, "greater human satisfaction in work is both compatible with and essential to increased efficiency and productivity".

A major consideration has been the slow advance of work in the human relations field, so that scientific standards will have to be raised, research methods improved and the general quality of work made more reliable. So far, the practical use to industry of such work has not been put across convincingly. This problem will have to be tackled and industry encouraged to apply the results of research to the maximum.

The main job of the Committee during the year has been the building up of a research programme. Seventy-eight projects were considered by the Committee and twelve of them have already been approved, their estimated cost being about £89,000. Others are still under consideration.

One project, on the effect of incentive payment schemes on productivity, is being carried out by Birmingham University. The experi-

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* *Human Relations in Industry*—Published by H.M.S.O. for D.S.I.R. and the Medical Research Council, England, Price by post 1 *s.* 1½ *d.*

ence of factories that have introduced incentive payments will be assembled and analysed, and account will be taken of trade union attitudes and experience. In previous work, the Edinburgh University had found that there was friction between inspection and production departments in some firms, which caused inefficiency. The work now in progress is directed to finding out how the inspection process can best be organised to avoid this.

Factors helping or slowing down technological change are given considerable importance in the Committee's programme. Liverpool University is studying the way in which new production methods and techniques can be absorbed without raising human problems. The research was initiated by a big steel firm, and the Liverpool team is co-operating with researchers in Holland, Germany, Belgium and other countries in order to compare results with them.

The Committee is particularly anxious that the results of the research should be known and acted upon in industry. In view of the difficulties of the latter and also of their possible applicability to industrial problems in our country, the concluding section of the Report is perhaps worth quoting: "In our contacts with people and organisations in industry, we have had our attention repeatedly drawn to the problem of applying research results in the human relations field. This is an especially difficult question in a field where, unlike the natural and medical sciences, there are few trained practitioners in industry, and where the applied research and other institutions exist. We have not yet had time to devote sufficient attention to this matter, but we feel it to be a matter of the utmost importance. As far as immediate action is concerned, the practical results of our research programme would undoubtedly be enhanced if researchers could keep in close touch with organisations able to assist the dissemination to industry of information about the research. For our part, we have under consideration various ways and means of fostering research application such as surveys to summarize available knowledge on subjects of practical importance and special publications of 'industrial' versions of research reports."

In this connection it is encouraging to note that in our country industrial research organisations like the ATIRA have already a social sciences unit attached to them. It is essential that everything should be done to quicken the pace of research on human relations in industry, in view of its bearings on the prosperity and well-being of our country.

# NEW EXPERIENCES WITH FOLIDOL-E 605, IN THE CONTROL OF RICE STEM-BORERS

P. ISRAEL AND G. VEDAMOORTHY

*Central Rice Research Institute, Cuttack-4*

STEM-BORERS are major pests of the rice crop in all rice-growing tracts of the Far East. In India, *Schœnobius incertellus* W., *Scirpophaga innotata* W., *Chilo simplex* B., and *Sesamia inferens* W., have been noted to cause damage to the rice crop, *Schœnobius incertellus* W., being the most serious of them. In Japan, where the stem-borer problem is acute, extensive damage is caused by *Chilo simplex* B.

The control of stem-borers has been a challenge to entomologists engaged in the control of rice pests. The introduction of the synthetic hydrocarbon insecticides raised some hopes, but the efficacy of these insecticides is rather limited as they can be directed only against adult moths and larvæ wandering outside on the leaves. Further, they do not act as ovicides nor can they kill the concealed borer larvæ inside the rice stem or sheath.

In recent years some organo-phosphorous compounds were tried against these pests in Japan and reported to be effective in the control of the stem-borer, *Chilo simplex* B.[2,3] Some of these are known to be systemic in their action (that is, the active ingredient can be absorbed by the plant tissue and translocated to other parts of the plant without causing any injurious effect to the plant itself), but Folidol-E 605 is stated to be capable of penetrating into the leaf-tissue only, which after short time decomposes rapidly into non-poisonous compounds. Reports from Japan have acclaimed Folidol-E 605 spraying as the only solution for combating the menace of rice stem-borer, *Chilo simplex* B.[3]

In order to exploit the penetrative property of Folidol-E 605, a preliminary experiment was laid out and the following treatments were introduced with variety D.I.4

$T_1$ *Check*: Seeds soaked in water for 24 hours and after sprouting, sown directly in seed-beds. $T_2$ *Seed Soaking*: Seeds soaked in 0·1 per cent. Folidol-E 605 for 24 hours and after sprouting sown directly in seed-beds. $T_3$ *Seed Soaking and Irrigation*: Same treatment as in $T_2$, followed by irrigating the seed-bed (50·3 sq. inches) and the transplanted crop (1,296 sq. inches) with 150 c.c. and 3,000 c.c. of 0·1 per cent. Folidol-E 605 respectively, at weekly intervals till flowering (7 irrigations in the field). Water in the transplanted crop was drained off a day before irrigating with Foli-dol-E 605. $T_4$ *Seed Soaking and Spraying*: Same treatment as in $T_2$, followed by spraying the seed-bed and the transplanted crop with 0·08 per cent. Folidol-E 605 at weekly intervals till flowering.

In all the treatments, seedlings 30 days old were transplanted in singles at 6″ spacing in square plots of 3′ × 3′ in well puddled field in three replications. Bunds were raised to a height of about 6″ all round each plot to facilitate irrigation with the insecticide or water. Each plot consisted of 6 rows with 6 plants to a row of which 1 row all round was left as border. The crop was observed every day, and tiller counts of individual plants were taken at weekly intervals. The following observations were made: (a) Seed soaking did not affect the germination in any manner; (b) Treatments $T_3$ and $T_4$ did not inhibit the growth of the seedlings in the nursery. On the contrary, the seedlings were more vigorous in growth. (c) There was no marked difference in growth between $T_1$ and $T_2$ in the nursery and the field. (d) Plants in treatment $T_3$ in the field were more vigorous, healthier and taller than those in treatment $T_4$, which in itself was better than $T_1$ and $T_2$.

At the time of harvest, counts of healthy earheads, white earheads due to borers, partially chaffy earheads due to borers, healthy and borer attacked non-ear-bearing tillers were taken. Earheads of individual plants were harvested and their weights recorded. The results show: (a) The percentage of white earheads is highest in $T_1$ (54·03) followed by $T_2$ (38·61). $T_4$ (20·99) is significantly less with regard to percentage of white earheads than $T_1$ and $T_2$ and significantly more than $T_3$ (1·21), (b) The percentage of grain-bearing earheads in $T_3$ (98·79) is significantly more than in the other three treatments and it is least in $T_1$ (45·97). $T_2$ (61·39) and $T_4$ (69·01) are not significantly different from one another. (c) $T_3$ (121·287) gives the highest yield which is significantly superior to the other three treatments followed by $T_4$ (60·660), $T_2$ (16·507) and $T_1$ (8·368). The difference in yield between $T_1$ and $T_2$ is not, however, significant (yield expressed in grammes per plot).

It is clear from the above results that neither seed soaking nor spraying alone is effective in controlling the stem-borer. Seed soaking fol-

lowed by irrigation with Folidol-E 605 has given an almost complete control of the stem-borer incidence.     Since seed soaking alone was not found to be much effective, irrigating the crop as described above, seems to be the only possible control.  By irrigating the plots with Folidol-E 605, the plants seem to have absorbed the active ingredient of Folidol-E 605 into their tissues and thus developed resistance to stem-borer attack. Inducing resistance by this method of sap absorption appears to be more feasible than evolving pest-resistant strains.

In view of the highly toxic nature of the insecticide, it is to be considered whether this method is practicable in the field. It is claimed by the manufacturers that the toxicity of Folidol-E 605 for man and animals is considerably reduced by the use of the special emulsifier and therefore no protective appliances are required while spraying the field. While conducting the experiments described above, no protective appliances were used. The conclusions of Deichmann, Hecht and Wirth[1] in their studies on the "Toxicity of E 605" are summarised below :  Folidol-E 605 is toxic to man by contact, ingestion or inhalation.  2·5 c.c. of this liquid is considered toxic through ingestion for a man of 70 kg. It is very improbable that this amount will be swallowed accidentally. In order to run the risk of death by contact with Folidol-E 605, the user should empty nearly the whole

content of the bottle of 1 litre on his body and remain for several hours without washing. But in practice, all that can happen is that a few drops of Folidol-E 605 may fall on the fingers of the user and as an elementary precaution, immediate washing is recommended.   Mortal danger by inhalation of Folidol-E 605 would only occur if the surrounding air contains more than 1 litre solution per cubic metre of air, and such a concentration is not usual while spraying Folidol-E 605 at the recommended dose. Details regarding the optimum time and dose of irrigations, the quantity required for irrigation, the quality of the straw and grain to find out if the insecticide is absorbed by them and if they are safe for consumption by man and animals, are under investigation.

The authors' grateful thanks are due to Dr. N. Parthasarathy for his interest in the work and critical reading of this note.

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2. Hajime Suenaga and Bunji Hashizume, *Bull. Kyushu Agri. Expt. Sta.*, 1953, 336.
3. Kisabu Iyatomi, *Shizuoka Agri. Expt. Sta. Pamphlet*, 1952, Tokyo, Japan.  "Preliminary Experiments on Systemic Insecticides against Rice Stem-borer ".

## ODOUR AND CHEMICAL CONSTITUTION

AN interesting correlation of odour with the pattern of molecular vibrations in the frequency range below 1,000 cm.[-1] is suggested by R. H. Write in *Nature* (1954, 173, 831). The Raman effect is at present the most convenient tool for the purpose.

A panel of fifteen observers was used to select sixteen compounds with an odour resembling that of nitrobenzene.  Of these compounds, all but one (nitrothiophene) were benzene derivatives, all but one (isocoumarane) had multiple bonds in the side chain conjugated with the ring. Apart from this general similarity of type, the compounds had such varied functional groups as nitro, nitrile, aldehyde, ketone, ester, etc.   When the low frequency Raman shifts of these compounds were

scrutinized, there was some evidence of a statistically significant correlation between the odour and the pattern of the Raman lines below 800 cm.[-1]

Raman lines below about 1,000 cm.[-1] appear to depend upon the whole configuration of the molecule more than on the constituent groups. Odour also appears to depend more on the whole configuration of the molecule, so that a correlation of odour with vibration would be more reasonable at low frequencies than at high. Moreover, the Planck formula shows that only normal vibrations with a wave number considerably less than 1,000 cm.[-1] have a significant possibility of being active at body temperature.

# THE CHROMOSOMES OF *OPHIOGLOSSUM RETICULATUM* L.

## A. ABRAHAM AND C. A. NINAN

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MANTON[2] in her pioneering work on the "Problems of Cytology and Evolution in the Pteridophyta" has shown that by a combination of modern cytological technique and the necessary manipulative skill and patience, the chromosomes of this group of plants can be studied and may well yield information of great value to the student of evolution. Taking advantage of the wealth of uninvestigated material of this group available in South India a cytogenetical study of this was started recently.

The purpose of this paper is to draw attention to certain striking observations on the cytology of *Ophioglossum reticulatum* L. The plants used in the study were all collected in the wild condition from four localities in South India and grown in pots in a fern house. The cytological and photographic technique followed were essentially similar to what was adopted by Manton.

collection showed 572 bivalents. The difference probably indicates the margin of error to be expected in determinations of such high numbers, though counts were made from very clear preparations and every care was taken to avoid errors.

*Second material* (from Parambikulam, 200 miles north of Trivandrum, in dense forest at an elevation of about 2,000'). One plant from this collection showed 566 bivalents at first meiotic metaphase, and this count agrees very closely with the first count of 564 bivalents from the Trivandrum material. But count from another plant from the same collection, and from a preparation which was exceptionally clear showed 631 bivalents and what appeared to be 10 fragments (or very small univalents?) (Figs. 1 and 2). This shows that the somatic cells of the sporophyte of this plant have over 1,260 chromosomes, the highest chromosome number yet discovered in any species. Attempts were made to get a somatic chromosome count from archesporial mitosis, and preparations
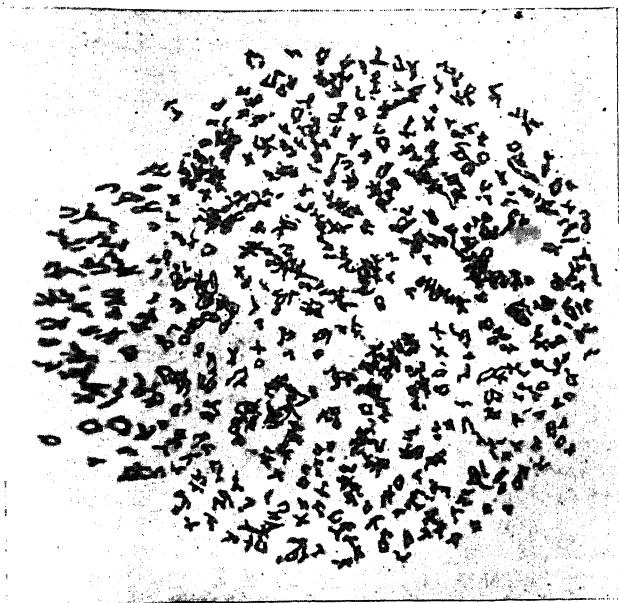


FIG. 1. Photomicrograph showing the first meiotic metaphase chromosomes in *Ophioglossum reticulatum*. (Parambikulam material). There are 631 bivalents and 10 fragments, × 500.



FIG. 2. Explanatory diagram of the same metaphase plate shown in Fig. 1, made on enlarged photographic print, and reduced to same size in reproduction.

*First material* (from Trivandrum City, sea coast). The spore mother cells clearly showed 564 bivalents at metaphase of first meiotic division. Count from another plant of the same

showing over 1,000 chromosomes in a single cell at metaphase were obtained.

*Third material* (from Ponmudi hill top, 40 miles north-east of Trivandrum at 4,000' elevation, growing in exposed grassland). The

plants from this locality showed smaller rhizomes, and the sterile part of the sporophyll was a little broader and the apex more rounded compared with specimens from the first two localities. A clear count of 451 bivalents was made in this plant. Also plants from this collection showed the largest chromosomes so far seen in this species.

*Fourth material* (from Ettapadappu, about 12 miles north-east of Ponmudi, in dense forest at 1,000' elevation). Plants from this area showed 436 bivalents at first metaphase of meiosis, the lowest chromosome number so far encountered in *O. reticulatum*.

In the course of this study we have examined several metaphase plates in preparations made from plants of each of the four localities, and have not so far seen any evidence of multivalent formation. The size of the chromosomes is appreciably large for a cell having such an extraordinarily large number. The spiral structure of the chromosomes is clearly visible in some preparations, and sometimes one component of a bivalent appears longer than its homologue on account of unequal relaxation of the spirals. From comparison of several counts in each material we are inclined to believe that the margin of error in determination of numbers will be under 2 per cent. The observed numbers in *O. reticulatum* from four different localities vary from 436 to 631 bivalents, indicating a range between 872 and 1262 chromosomes in the sporophytic tissue.

Two points deserve consideration in this connection :—(1) the mode of origin of such a large number, and (2) the significance, if any, of the difference in numbers observed in materials of the same species and of closely related species from different geographical regions. A survey of the known chromosome numbers in seed plants[1] shows that higher numbers have evolved from smaller numbers by polyploidy. That more or less the same process has been operative also in the evolution of the lower vascular plants is seen from Manton's observations.[2] That a polyploid series exists in the genus *Ophioglossum* is evident from Manton's record of $n = 128$ in *O. lusitanicum* and $n = 256$ in *O. vulgatum*. Both species showed only bivalents at meiosis, and in the absence of record of any lower numbers in the genus it was difficult to decide the basic number. The present observations show that while *O. vulgatum* from Manchester has a diploid chromosome number of over 500, the Parambikulam material of *O. reticulatum* has more than 1,260 chromosomes. It seems that allo- or auto-polyploidy or a combination of the two may have

been operative in this genus at some stage in its long history. But the fact that only bivalents are formed at meiosis, whether the somatic number is 256, 512 or 1,262, makes it difficult to decide this question. There is the possibility that these are very ancient polyploids, which in the course of thousands or millions of years might have through the accumulation of genic changes become functionally diploids. And any disadvantage arising from such a multiplication of chromosomes may have been counterbalanced by the parallel attainment of a vegetative mode of reproduction through root buds. Again, it is not improbable that our currently accepted ideas regarding multivalent formation and secondary associations, based largely on observations on favourable angiosperms with small number of medium- or large-sized chromosomes do not hold good in every respect as far as plants with such large numbers and consequently small-sized chromosomes are concerned. A re-examination of these concepts may be necessary in the light of observations on these ancient plants.

It is of interest to enquire whether there is any relationship between chromosome numbers and geographical distribution. If we accept the idea that generally higher numbers are derived from smaller numbers in the course of evolution, it follows that within the same species material from the older strata of the earth's crust, which have longest escaped great geological upheavals would show higher chromosome numbers compared with materials of the same from relatively more recent formations. This relationship may possibly hold good for closely related species as well. The peninsular part of India, comprising the whole of South India, constitutes one of the oldest of such land masses, and it may be expected that in species indigenous to this region higher levels of polyploidy may be seen within any group of closely related species as compared with materials of the same from later formations. An extensive and careful investigation of the tropical Pteridophytes may provide some answer to this and related problems of evolution.

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# LETTERS TO THE EDITOR

## NUCLEAR SHELL NUMBERS IN LIGHT ELEMENTS

THE nuclear scattering of 340 Mev. protons by various elements has been observed by Richardson, Ball, Leith and Moyer.[1] These experimental observations have been theoretically correlated on the basis of the optical model of the nucleus proposed by Fernbach, Serber and Taylor.[2] Using the radial distribution method Gatha, Shah and Patel[3] have obtained a characteristic nuclear density distribution for light elements given by

$$\rho\,(\bar r) = \sum_{q=1}^{3} a_q \exp\,(-\beta_q\,\bar r^2) \qquad (1)$$

where

$$a_1 = 0\cdot25 \times 10^{39}\,\text{cm.}^{-3}, \quad \beta_1 = 28\cdot94 \times 10^{26}\,\text{cm.}^{-2},$$
$$a_2 = 0\cdot19 \times 10^{39}\,\text{cm.}^{-3}, \quad \beta_2 = 3\cdot83 \times 10^{26}\,\text{cm.}^{-2},$$
$$a_3 = 0\cdot10 \times 10^{39}\,\text{cm.}^{-3}, \quad \beta_3 = 0\cdot75 \times 10^{26}\,\text{cm.}^{-2},$$

and

$$\bar r = r \times A^{-1/3}.$$

We have tested the validity of the nuclear density distribution proposed by us from the point of view of nuclear shell numbers for light elements. On the basis of the Thomas-Fermi nuclear model, a correlation has been established by Born and Yang[4] as well as by Yang[5] between the nuclear density distribution

and nuclear shell numbers. It can be written as

$$N_l = (l+3/2)^3/3\pi^2 \bar{r}_m{}^3 \, \rho \, (\bar{r}_m) \qquad (2)$$

where $N_l$ = the number of neutrons or protons in the completed shell characterised by the angular momentum $l$,

$\bar{r}_m$ = the value of $\bar{r}$ where $\bar{r}^3 \rho (\bar{r})$ is a maximum,

$\rho (\bar{r}_m)$ = the nuclear density at $\bar{r}_m$.

For the nuclear density distribution obtained by us $\bar{r}_m \simeq 1 \cdot 4 \times 10^{-13}$ cm. while $\rho (\bar{r}_m) \simeq 0 \cdot 023 \times 10^{39}$ cm.$^{-3}$. The nuclear shell numbers given by our density distribution are $1 \cdot 8$, $8 \cdot 4$ and $23 \cdot 1$ for $l = 1, 2, 3$ respectively which may be compared with empirically obtained values of 2, 8 and 20. Thus the nuclear density distribution is approximately consistent with this requirement.

M. G. Science Institute,　　　　　　G. Z. SHAH.
Navarangpura,　　　　　　　　　　K. M. GATHA.
Ahmedabad-9, *April* 27, 1954.

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## UNIT CELL AND SPACE-GROUP OF MORELLIN

IN a previous note,[1] one of the authors published a preliminary report on the unit cell dimensions and space-group of Morellin, an antibiotic from *Garcinia morella*.[2] Detailed considerations however threw some doubt regarding the space-group, in which the crystal was placed and it was taken up for re-examination and closer study. Good single crystals were kindly lent by Dr. P. L. N. Rao and his co-workers, of the Biochemistry Department.

Oscillation and Weissenberg photographs of very long exposures of the zero and higher layers have confirmed the previous measurements and observations in general. The crystal belongs to the tetragonal system, with the following unit-cell dimensions, $a = b = 15 \cdot 89$, $c = 11 \cdot 6$ Å. Looking for the systematic extinctions, it is found that only in reflexions of the type $(00l)$, the observed ones are those for which $l = 4n$, and hence it suggested, that the $c$-axis is $4_1$ and not $4_2$. The previous space-group in which it was placed, *viz.*, P4₂/*m* has

an eight-fold general position and since there are only four molecules per unit cell, all the atoms have to be in very special positions, *viz.*, in two layers with parameters $x, y, 0$; $\bar{y}, \bar{x}, 0$; $\bar{y}, x, \frac{1}{2}$; $y, \bar{x}, \frac{1}{2}$. For a very complex molecule of the type of Morellin which shows pronounced optical activity in solution, it is a highly inconceivable arrangement, a conclusion further augmented by the fact that there is no cleavage plane perpendicular to $c$, and that the reflections of the type $00l$, $l = \text{B}\,n$ have not been observed at all. This leaves no doubt about the nature of the screw axis. Finally the crystal exhibits pronounced optical activity under the polarising microscope, which eliminates all the centro-symmetric space-groups. These observations conclusively prove that the space-group is $P4_1 - C_4^2$. Detailed analysis is under progress.

Our grateful thanks are due to Prof. R. S. Krishnan for his kind interest in the work.

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*June* 10, 1954.

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(* Now in the Physics Department, University of Madras).

## AMPEROMETRIC DETERMINATION OF FERRICYANIDE WITH SILVER NITRATE

THE volumetric method for the estimation of the ferricyanide[1] does not give satisfactory results at low concentrations. This investigation was undertaken with a view to estimating small amounts of ferricyanide by amperometric titration with silver nitrate. The manual polarographic arrangement[2] for the titrations using dropping mercury electrode as cathode was employed. In view of the reaction between potassium ferricyanide and mercury,[3] instead of the usual stationary mercury pool, an external saturated calomel electrode was used as a reference anode. Purified nitrogen was bubbled through the solutions to remove the dissolved oxygen. Gelatin was added for suppressing the current maximum. The supporting electrolyte was $0 \cdot 1$ M solution of potassium nitrate. The ferricyanide solutions were taken in the titration cell and the silver nitrate solution was added stepwise from a micro burette. The titrations were carried out at a potential

of — 0·3 volt vs. S.C.E., where the diffusion current due to the reduction of the $Fe(CN)_6^{---}$ as well as $Ag^+$ ions have a limiting value. After each addition of silver nitrate, the solution was well agitated by bubbling nitrogen through it and the precipitate was allowed to settle clear of the capillary tip before measuring the current.

A typical curve for the titration of 50 ml. of $2·811 \times 10^{-3}$ M potassium ferricyanide with 0·2497 M silver nitrate gave two intersecting straight lines for various volumes of silver nitrate added. Titrations of 1·6 to 5 millimolar ferricyanide solutions have been carried out. In each case, the composition of the precipitate at the equivalence point corresponded to $Ag_3Fe(CN)_6$. This confirms the previous findings by conductometric[4] and thermometric[5] methods regarding the composition of the precipitate obtained in the $AgNO_3$-$K_3Fe(CN)_6$ titration.

### Table I

*Amperometric titration of potassium ferricyanide with silver nitrate*

Volume of ferricyanide solution = 50 ml. ; E.M.F. applied = — 0·3 volt. vs. S.C.E. ; Temperature = $30 \pm ·05°$ C.

| Strength of $AgNO_3$ soln. | Strength of $K_3Fe(CN)_6$ soln. in $10^{-3}$ M | Calculated titre value in ml. | Observed titre value* in ml. |
|---|---|---|---|
| 0·50 M | 5·022 | 1·51 | 1·52 |
| do | 4·016 | 1·21 | 1·20 |
| do | 3·213 | 0·97 | 0·98 |
| do | 3·012 | 0·91 | 0·91 |
| 0·25 M | 2·811 | 1·69 | 1·68 |
| do | 2·409 | 1·45 | 1·46 |
| do | 1·848 | 1·09 | 1·08 |
| do | 1·606 | 0·97 | 0·96 |

* Mean of three readings.

It would appear from the table that in most cases the results are within 1 per cent. of the calculated titres. The individual titres were within $\pm 0·01$ ml. of the mean values. The titration can thus be used for estimation of dilute solutions of ferricyanide with silver nitrate.

Our thanks are due to Prof. R. P. Mitra for suggestions and interest in the work.

University of Delhi,
Delhi, *May* 18, 1954.

BALDEV KHOSLA.
HARISH C. GAUR.

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3

## ON THE PYROPHYLLITE DEPOSITS OF TIKAMGARH

THE pyrophyllite deposits of Bundelkhand were for the first time studied in detail by R. C. Misra.[1] He has shown that the so-called Steatite deposits of Hamirpur, U.P., are deposits of pyrophyllite.

The pyrophyllite deposits (78° 55′, 24° 51′) described here lie between the villages Mawai and Kari in Tikamgarh District (Vindhya Pradesh). The country rock is Bundelkhand granite and the pyrophyllite deposits are found in a large quartz vein 1207′ above the sea level. There is no trace of any basic rock near this deposit.

The usual rock is a pink granite which becomes gneissose near the quartz vein. This gneissose granite shows an augen structure. Pyrophyllite occurs in the quartz reef in the form of lenticular masses parallel to its strike. The most evident and easily observed feature is the prominent schistosity of the pyrophyllite rock. The strike of this rock varies from N-S to NNE-SSW. In the field, the rock looks like a variegated slate and breaks into splinters. The different pyrophyllite bodies grade in both directions along the strike into the quartz-pyrophyllite rock and quartz rock. The typical quartz-pyrophyllite rock has a schistose appearance with alternate bands of quartz and pyrophyllite.

Pyrophyllite varies in colour from nearly black to green and to pinkish red. It has a greasy feel and its hardness is about 2. The minerals observed in thin sections associated with the deposits are pyrophyllite, quartz, feldspars, rutile, apatite, zircon, limonite and hæmatite.

Pyrophyllite occurs in the form of scales and is often tabular in habit. The individual scales grow much bigger near the contact of quartz grains. The quartz shows wavy extinction and occurs in the form of thin veins with corroded margins. Orthoclase and microcline are the common feldspars which are much altered giving rise to pyrophyllite and sericite along their margins and cleavages. The margin of the feldspar is usually much corroded. Feldspars are not found in a pure pyrophyllite rock. Rutile and zircon are the common accessories. Rutile occurs in the form of prismatic reddish brown crystals with very high refractive index and showing adamantine lustre in reflected light.

Under the microscope the pyrophyllite is seen to be the last mineral formed. It has

originated at the expense of the feldspars. In a pure pyrophyllite rock there is practically no trace of feldspar, but quartz is always present and shows corroded outline. Quartz grains are often cracked and along these cracks pyrophyllite is formed replacing the former.

Both the field and the petrographic evidences in the present case show that the pyrophyllite has originated through the process of metasomatic replacement of quartz veins by hydrothermal solutions. The same mode of origin has been suggested by R. C. Misra for the deposits he has examined.[1]

Dept. of Geology,                B. B. S. SINGHAL.
Banaras Hindu University,
Banaras, *March* 9, 1954.

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## COMBUSTION STABILIZATION IN LOW VELOCITY GAS-STREAMS

THE object of this investigation was to stabilize the combustion over a wide range of air/fuel ratios, and to reduce the reaction length in a small combustion chamber, designed to operate at high temperatures at atmospheric pressure. For this purpose experiments were carried out with a cylindrical baffle in a combustion chamber.

As a stream of burning and unburnt gases passes over a baffle, certain phenomena occur very rapidly in the wake region. The flow separates over the baffle and a series of eddies is formed in the immediate downstream region. A rapid heat-transfer from the flame to the colder unburnt gases takes place and the latter are raised to the ignition temperature and begin to burn. At the same time, there will be a recirculation of the hot gases in the eddy region, thus furnishing a continuous source of ignition for the unburnt gases. The re-circulation in the wake of the baffle gives rise to vortices which stabilize the flame.[2] This can be explained on reference to Fig. 1. At *a*, there
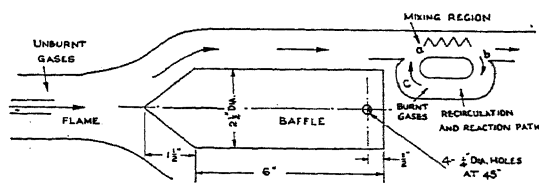
will be mixing of unburnt gases with the flame, because the burning gas is retarded at the baffle surface due to friction, and the unburnt gas forming the outer boundary travels into the slowly moving flame region at *a*. At *b*, the burning continues, and some of the burnt gas which cannot cope with the pressure barrier there, falls into the vortex and is fed back at *c*, thus furnishing a continuous supply of hot gas for the combustion of unburnt gases. The flame length is cut down, because all the burning takes place at *b*, and combustion is smooth and continuous.

The experiments were carried out in a combustion chamber designed to operate at high temperatures at atmospheric pressure. The set-up consisted of a blower delivering 10 lb. of air per minute to the combustor and a gear pump driven by a variable speed DC motor which supplied the fuel (kerosene oil) at a pressure of 150 psi. The length of the combustor was 18″. The stabilizing baffle was mounted centrally in a pipe 12″ long which was fitted to the combustor exit. The total length of the combustor and stabilizer unit was 30″.

The design of the stabilizer is based on the work of Longwell *et al.*[1] who investigated the phenomena of flame stabilization in high velocity gas streams by baffles. The baffle for the present tests was made of stainless steel. It is 6″ long and 2½″ diam. with the conical end facing upstream. At the downstream end four inclined holes are drilled to produce better mixing in the region *a*. A traversing pitot tube was fitted to the combustor exit for measuring the velocity head.

FIG. 2. AIR-FUEL RATIO vs. VELOCITY PAST BAFFLE
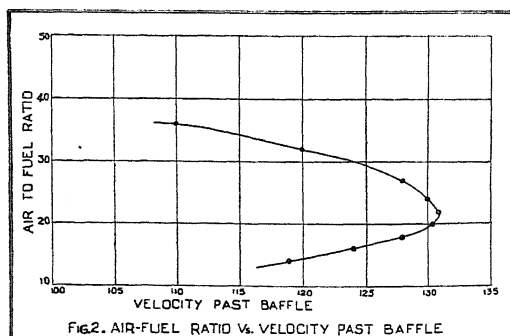
The combustor was operated at different fuel-air ratios starting from a minimum of 40 : 1. The velocity past the baffle was measured for different fuel-air ratios. The upper limit of fuel-air ratio was 14 : 1 when blow out occurred. The performance of the baffle can be seen in Fig. 2 where the velocity past the baffle (in

FIG. 1.  Flame Stabilization by Re-circulation.

ft./sec.) is plotted against the air-fuel ratios. It is seen that the velocity gradually increases with richer mixture ratios and is a maximum at about 22 : 1. The velocity again decreases and reaches a minimum at 14 : 1 when blow out occurs.

The baffle stabilizer improved the performance of the combustor. Before the introduction of the baffle the lower and upper air-fuel ratio limits were 1 : 30 and 1 : 18. With the stabilizer, the combustor could be smoothly operated between the air-fuel ratio limits of 1 : 14 and 1 : 36. Further, the flame length beyond the combustor exit was cut down from 3 ft. to a few inches beyond the baffles.

Mech. Engg. Section,          G. Srikantiah.
Dept. of Power Engg.,          A. Ramachandran.
Indian Institute of Science,
Bangalore-3, *April* 7, 1954.

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## THE ADDITION OF BROMINE TO $\alpha$-$\beta$ UNSATURATED ACIDS IN CARBON TETRACHLORIDE SOLUTIONS

KINETIC investigations of this reaction in glacial acetic acid have been reported from time to time.[1] These observations suggest that it is worthwhile studying solvent influences since relative rates appeared to be different from the results of competitive reactions.[2,3] It was anticipated that the reaction would be heterogeneous in view of the work of D. M. Williams and of Gwyn Williams.[4,5] To avoid the com-
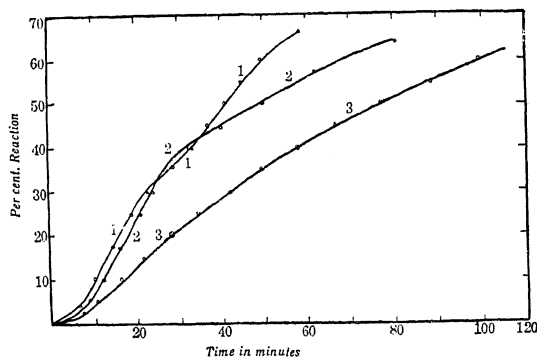


FIG. 1

1.—Pyrex; 2.—Silica; 3.—Alumina;
Reactants M/15 at 30·1° C
$\beta\beta$ dimethyl acrylic acid + Bromine

plication of peroxide effect, these unsaturated acids were chosen for study.

Typical observations are shown in the accompanying figures (1 and 2). Fuller details
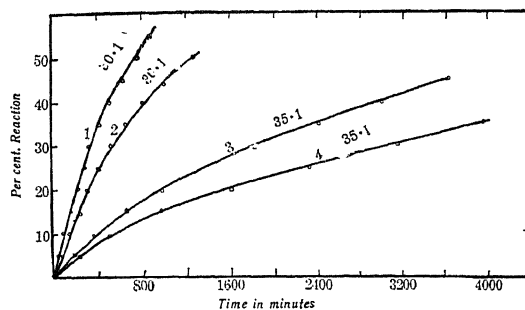


FIG. 2

Transcrotonic Acid + Bromine
1.—Pyrex (temp. 30·1°); 2.—Silica (temp. 30·1°);
3.—Pyrex (temp. 35·1°); 4.—Silica (temp. 35·1°).

are presented elsewhere. The reagents were carefully purified as with the work in acetic acid and the reactions were carried out in complete darkness. The vessels and the added beads of silica or pyrex glass were treated in an identical manner so that the conditions were quite reproducible within the limits of experimental error.

The reactions are definitely heterogeneous, the rate depending on the degree of packing, temperature, nature of surface, concentration and structure of the reactants. The time for a given fraction of the reaction to take place is a convenient criterion for purpose of comparison and the results for such a comparison are given in Table I.

|  | Concentration of acid | Concentration of Bromine | Time for 10% reaction at 35·1° C. | | |
|---|---|---|---|---|---|
|  |  |  | Pyrex | Silica | None |
| A | 0·1 M | 0·1 M | 370 min. | 465 min. | 800 min. |
|  | 0·05 M | 0·05 M | 450 min. | 750 min. | 1590 min. |
| B | 0·05 M | 0·05 M | 13 | 10·2 | 29·5 |
|  | 0·025 M | 0·025 M | 78 | 77 | 750 |

A. With crotonic acid ; B. with 2 : 2 dimethyl acrylic acid.

The complex nature of a heterogeneous reaction makes the determination of rate constants or of reaction order of doubtful utility for absolute evaluations but are nonetheless useful in a comparative study. Using comparisons

of initial rates and the time for half reactions, some broad generalisations are, however, possible. These values lead to an order of reaction which is initially about four gradually fading off to three and then possibly to two. It is clear that the reaction taking place is between the adsorbed molecules of reactants polarised by the polar surface. A serious objection to a high order reaction is the definite positive temperature coefficient for the reaction in some olefines.

The specific influence of surface also appears to be governed by the nature of the olefine; while silica and pyrex surfaces show appreciable differences in the case of trans-crotonic acid, the difference is negligible with dimethyl acrylic acid. This difference can arise partly from the steric course of the reaction and partly by the superposition of a homogeneous phase in the reaction which might be initiated at the surface. Further work is in progress to examine this aspect of the problem.

The reaction is more sensitive to changes in bromine concentration than to that of the olefine. Starting with M/5 solutions of both reactants while halving the olefine concentration increases the time for 10 per cent. reaction by 50 per cent., halving the bromine concentration causes an increase in the time by over 150 per cent. Fuller details and a consideration of the mechanism will be published elsewhere.

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## THE PREPARATION OF PHENOLIC KETONES AND CHALKONES BY MEANS OF BORON TRIFLUORIDE

IN carrying out the first synthesis of 5 : 6 : 7-trihydroxyisoflavone and its 5 : 7-dimethyl ether it was shown that 2 : 5-dihydroxy-4 : 6-dimethoxyphenyl benzyl ketone can be prepared by the condensation of 2 : 6-dimethoxyhydroquinone (I) with the boron trifluoride complex of phenylacetic acid.[1] The phenol (I) was shown by Chapman, Perkin and Robinson to be unreactive in the Hoesch and Friedel-

Crafts reactions.[2] The use of acid-boron trifluoride complexes is a convenient general method for the preparation of phenolic ketones and chalkones by the Nencki reaction. Thus, when the phenol (I) or antiarol is dissolved in the commercially available boron trifluoride-acetic acid complex (BF$_3$, CH$_3$COOH) and poured into ice after leaving overnight at room temperature, the corresponding acetophenones are obtained in 60-70 per cent. yield; Mauthner[3] prepared 2 : 5-dihydroxy-4 : 6-dimethoxyacetophenone by the Fries migration of the diacetate of (I) and Sastri and Seshadri[4] by the persulphate oxidation of phloracetophenone dimethyl ether. 2-Hydroxy-4 : 5 : 6-trimethoxyacetophenone has been prepared very recently by Krishnamurti and Seshadri[5] in a yield of about 30 per cent. by the Friedel-Crafts reaction between antiarol and acetyl chloride.

Resorcinol and pyrogallol react with boron trifluoride-acetic acid complex at room temperature, giving resacetophenone and gallacetophenone in 80-90 per cent. yield; with $\beta$-naphthol a boron-trifluoride complex (m.p. 184°) of the ketone is first obtained and boiling with water for a few minutes gives 1-acetyl-2-naphthol in 93 per cent. yield.

When cinnamic acid (2 mol.) in chloroform is saturated with boron trifluoride, resorcinol is added, and the solution is left overnight at room temperature, 2 : 4-dihydroxychalkone (II) is obtained in 70 per cent. yield.[6] Pyrogallol under similar conditions gives an 80 per cent. yield of the corresponding chalkone.[7]

Treatment of the chalkone (II) with tosyl chloride (1 mol.) in aqueous sodium carbonate yields the monotosylate, which can be cyclized readily to 7-tosyloxyflavone (III) by means of selenium dioxide.[8] Caustic potash in aqueous acetone at room temperature overnight hydrolyses (III) to 7-hydroxyflavone. The selenium dioxide oxidation of chalkones, which is often the most convenient route to flavones, can thus be utilized for hydroxyflavone syntheses not involving demethylation.

Antiarol condenses readily with the boron trifluoride complex of cinnamic acid to give 2-hydroxy-4 : 5 : 6-trimethoxychalkone (IV), yellow needles, m.p. 100°, oxidizable by selenium dioxide to baicalein trimethyl ether. Oliverio and Bargellini[9] quote the m.p. 103-04° for the chalkone (IV), which they prepared by the usual benzaldehyde condensation; Rajagopalan and Seshadri[10] obtained a bright yellow liquid, which could not be crystallized, but Narasimhachari, Sastri and Seshadri[11] described

it subsequently as yellow broad rectangular plates melting at 132-33°.

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## SOLVENT REFINING OF GROUNDNUT AND MOWRAH OILS BY ETHYL ALCOHOL

IN studying the suitability of ethyl alcohol for deacidification of some vegetable oils by liquid-liquid extraction, the following features have been noticed (Fig. 1).
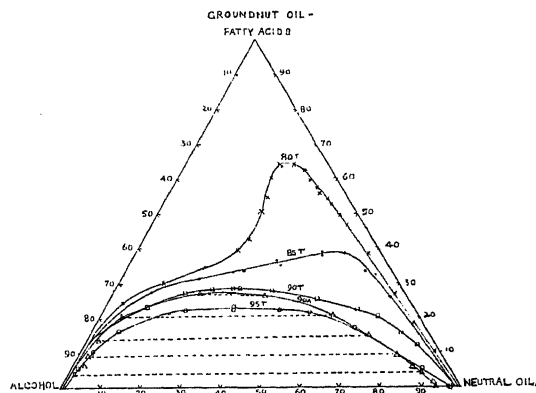


FIG. 1. Mutual solubility curve for the system : Neutral groundnut oil-Fatty acids-Alcohol. Curve 90 A obtained by the ' agitation ' method. Curves 95 T, 90 T, 85T and 80 T obtained by the ' turbidity' method.

1. The tie lines (shown dotted in the figure) of the mutual solubility curve, 90 A, are practically horizontal showing that ethyl alcohol (90 per cent. by weight) is non-selective at room temperature (30 ± 2° C.) and 'at atmospheric pressure, as far as the mixed fatty acids and the mixed glycerides of the two oils are concerned.

2. All the mutual solubility curves were obtained by the 'Turbidity' method.[1] In the case of 90 per cent. ethyl alcohol, the 'Agitation' method was also employed to see if the solubility curves obtained by the two methods agreed. In the latter method, the three weighed components, *viz.*, neutral groundnut oil, groundnut oil fatty acids and ethyl alcohol were shaken in a stoppered separating funnel for 2 hours and the mixture was kept overnight for separation into two layers. The oil layer was completely withdrawn and analysed. Alternatively, portions from the two equilibrium layers were withdrawn and analysed for the three components in each. Thus, the composition of the two phases was known and several pairs of such equilibrium phases were analysed. It was found that the solubility curves by the two methods did not agree (curves 90 A and 90 T) and that the deviation was greater on the oil side. It has been confirmed that the observed deviation is not caused by changes in temperature of measurement to the extent of ± 2° C. Although it is not possible at this stage to give the real explanation for this deviation, the difference in the conditions under which estimations by the two methods are carried out might be one of the reasons.

3. With the use of more dilute alcohol, the region of heterogeneity has naturally increased, but in addition, a hump also has appeared in the mutual solubility curve to its right. A distinct hump is seen with 80 per cent. ethyl alcohol indicating sudden decrease in the solubility of oil and its fatty acids in ethyl alcohol. A similar abnormal behaviour was noticed by Othmer and Serrano[2] in the system, acetic acid—caproic acid—water. They have stated that "chemical association of either caproic or acetic acids or of one or both of the acids and water may be the reason of this abnormality".

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## A SIMPLE PAPER CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF LACTOSE IN MILK

RECENTLY Honer and Tuckey[1] have described a paper chromatographic method for quantitative estimation of lactose in milk. The lactose was determined by cutting the paper containing

the sugar after separation into a series of segments and estimating the sugar in each segment using the alkaline ferricyanide reagent. The authors state that the procedure as described by them is time-consuming and would therefore not be an appropriate method for lactose determination in a control laboratory.

A simple paper chromatographic procedure is now described by which the lactose content of milk can be determined quantitatively. The method consists in spotting an accurate amount (20 $\mu l$) of diluted milk (10 g. of milk diluted to 100 ml.) on the circumference of a circle (4 cm. diam.) drawn at the centre of a circular filter-paper (Whatman No. 1, 18 cm. diam.) and known amounts of standard solution of lactose on either side of the milk spot. After the spots are dried the paper is developed with the solvent mixture of n-butanol-acetone-water (20-70-10). After the completion of development the paper is dried and treated with the reagent triphenyl tetrazolium chloride according to the procedure described by Giri and Nigam[2] for the separation and determination of sugars by circular paper chromatographic technique. The red bands of lactose are then cut, the colour extracted with 95 per cent. alcohol and estimated in a Klett Summerson Photoelectric Colorimeter.

The following table gives the percentage of lactose in some of the samples of cow and buffalo milk analysed by the method described above together with the percentage recovery of added lactose to cow milk:

| Sample No. | Lactose (per cent.) | Recovery (per cent.) |
|---|---|---|
| | Cow Milk | |
| 1 | 4·3 | 91 |
| 2 | 4·4 | 97 |
| 3 | 4·3 | 93 |
| | Buffalo milk | |
| 4 | 4·6 | .. |
| 5 | 4·8 | .. |
| 6 | 4·7 | .. |

The method is accurate to ± 10 per cent.

Quickness and simplicity of operation combined with accuracy are the unique features of this method which can be recommended for routine analysis of milk samples. Another advantage of the chromatographic method is that it demands less skill and it is more specific than other methods in which sugars other than lactose when present in milk vitiate the results. A number of samples can be analysed rapidly at a time, which is of great significance

in routine analysis of milk samples. In practice it is convenient to chromatogram large number of samples at a time and estimate the colour by extraction later, as it is found that the colour remains stable for a long time.

Since lactose is the least variable among the major constituents of milk, the method can be used for detecting the adulteration of milk with water or other sugars in control laboratories where numerous samples come in for quick disposal.

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## SUGAR CONSTITUENTS OF THE SAPONIN FROM MAHUA OIL CAKE (*BASSIA LATIFOLIA*)

EXCEPT the work of Van der Haar,[1] no study appears to have been made of the qualitative composition of the sugar mixtures present in the hydrolysis of saponins, obtained from seeds of various *Sapotaceæ*. The present work was undertaken to identify the sugars in the hydrolysate of the saponin from *Bassia latifolia* by the latest method of paper chromatography according to Partridge.[2]

The saponin was isolated from the mahua oilcake (kindly supplied by the Swastik Oil Mills, Bombay) and purified by removing pectin by repeated precipitation with alcohol in the usual way.[3] It was a light brown hygroscopic powder with an ash content of 0·4 per cent. A chromatographic study of the sugar mixtures of the saponin hydrolysate revealed the presence of glucose, arabinose, xylose and rhamnose, in which glucose and rhamnose predominated. The absence of galacturonic acid[3] in the paper chromatography of the hydrolysate showed the saponin to be free from pectin. By using the osazone method, Van der Haar[1] found the presence of glucose, arabinose and rhamnose in the saponins from *Mimusops elengi* and *Archas sapota,* two different species of the *Sapotaceæ* family. The osazone method has its limitations for separation and characterisation of the components of a sugar mixture and is much less versatile compared to paper chromatography. The work of Van der Haar therefore requires re-examination.

In the present study, the qualitative characterisation of the unknown sugars was carried through the parallel spotting of the known pure sugars by the "descending" method and not through the absolute Rf values. The systems, (a) n-Butanol-acetic acid-water (4 : 1 : 5) for 48 hr. and (b) phenol for 24 hr. were made use of, while aniline oxalate was used as the spraying agent.

The presence of free sugar in the "glucoside", as indicated by paper chromatography, was negligible. Further work is in progress and the details will be communicated later.

My sincere thanks are due to Prof. R. C. Shah for his kind interest in the work and to Dr. S. C. Bhattacharyya and Mr. R. S. Davalikar for the help rendered in the course of the work.

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## THE SEPARATION OF AMINO ACIDS BY BUFFERED CIRCULAR PAPER CHROMATOGRAPHY

A METHOD for the separation of the overlapping amino acids by circular paper chromatographic technique has recently been described by Giri and Rao.[1] This involves the complicated procedure of cutting out, eluting and spotting the overlapping amino acids and rechromatographing with suitable solvents. Recently, McFarren[2] has published a new modification of one-dimensional technique for the separation and identification of the different amino acids from a mixture, by employing filter-paper and solvents buffered at selected pH. This method is a distinct improvement over the existing methods as it has made it possible for the first time the separation and identification of the different amino acids by one-dimensional chromatographic technique. In the present investigation the separation of the commonly occurring amino acids by buffered circular paper chromatographic technique has been studied. A preliminary account of the results is reported in this communication.

The apparatus used for the circular paper chromatographic technique was the same as that described by Giri and Rao.[3] The following solvents used by McFarren[2] for the separation of amino acids on filter-paper sheets

using unidimensional technique were tried : (1) Phenol saturated with 12·0 pH buffer in conjunction with circular filter-paper (Whatman No. I) buffered at the same pH, (2) m-cresol saturated with 8·4 pH buffer using circular filter-paper buffered at the same pH. The composition of the buffers were the same as that described by McFarren.[2] The chromatograms were developed twice in each case as
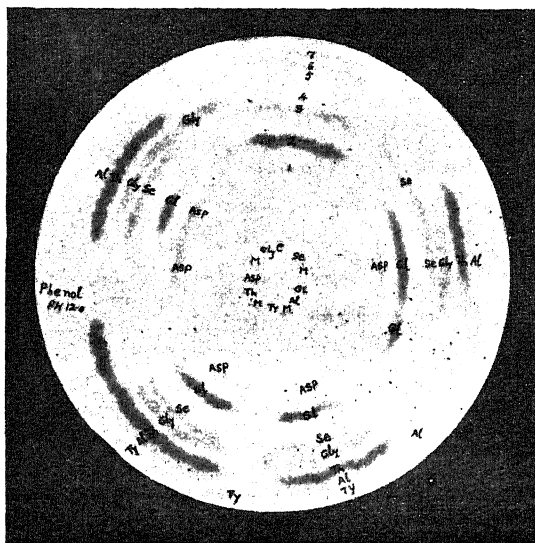


FIG. 1. Circular paper chromatogram showing the separation of amino acids : Solvent ; Phenol saturated with 12·0 pH buffer.
  C : Casein hydrolysate ; M : Mixture of known amino acids ; Gl : Glutamic acid ; Se : Serine ; Al : Alanine ; Ty : Tyrosine ; Th : Threonine ; Asp : Aspartic acid ; Gly : Glycine.

suggested by Jeanes, Wise and Dimler[4] for the separation of carbohydrates. The chromatograms were irrigated for about 8 hours each time, after which they were dried at 80° C. for 3 minutes. After the second irrigation, the chromatograms were dried at 80° C. for 3 minutes, and uniformly sprayed with an acetone solution containing 0·2 per cent. ninhydrin and 5 per cent. acetic acid and heated at 80° C. for 5 minutes to develop the colour produced by the amino acids.

The results show that (1) m-cresol saturated with buffer of pH 8·4 gives a clear separation of alanine, arginine, tyrosine, histidine, valine, methionine and phenylalanine, and (2) phenol saturated with a buffer of pH 12·0 causes a satisfactory separation of aspartic acid, glutamic acid, serine, glycine, threonine and alanine. Photographs of typical chromatograms showing

the separation of different amino acids are shown in Figs. 1 and 2.
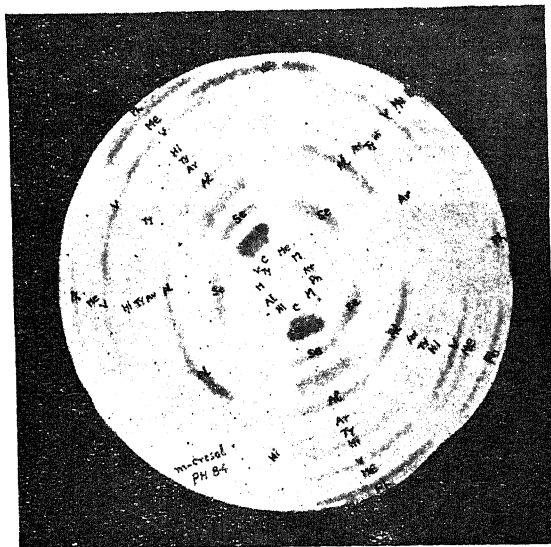


FIG. 2. Circular paper chromatogram showing the separation of amino acids. Solvent: *m*-cresol saturated with 8·4 pH buffer.

C : Casein hydrolysate; M : Mixture of known amino acids; Me : Methionine; V : valine; Ar : Arginine; Ph : Phenylalanine; Hi : Histidine; Al : Alanine; Ty : Tyrosine; Se : Serine.

Our thanks are due to Dr. V. Subrahmanyan, Director of this Institute, for his keen interest in this work.

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## TRYPTOPHANE UTILISATION BY *NEUROSPORA CRASSA* AND THE INFLUENCE OF PURE AMINO ACIDS

ONE of the factors which seemed to affect the conversion of tryptophane to nicotinic acid was the influence of certain proteins, when fed at lower levels with tryptophane-low or nicotinic acid free ration. The adverse effect produced by the proteins was overcome by the addition of tryptophane or nicotinic acid.[1,2] This relationship of the 'level of dietary protein' and 'nicotinic acid requirement' first established in rats was subsequently confirmed in the case of chicks,[3] pig[4] and dog.[5] The adverse effect produced by the proteins was attributed to the various amino acids present in them and in turn to their influence on the digestive tract.[6,7] Later work,[8,9] suggested that the effect of the protein or the amino acids contained therein might result from an inhibition in the conversion of tryptophane to nicotinic acid by affecting certain enzyme systems in it, rather than from an introduction of an increased requirement of nicotinic acid brought about by the micro-organisms. To elucidate this observation further, experiments were carried out to find the influence of various amino acids on the utilisation of tryptophane by *Neurospora crassa*.

A nicotinic acid dependent strain of *Neurospora crassa* (39401) kindly supplied by Dr. H. K. Mitchell, of California Institute of Technology, was used. Strain 39401 is able to utilise all the metabolites of tryptophane for nicotinic acid synthesis and the gene is located at the precursor—indole linkage as illustrated the accompanying scheme :

gene block
↓
precursor ⟶ indole ⟶ tryptophane ⟶ kynurenine 3-hydroxykynurenine ⟶ ⟶ 3-hydroxy anthranilic acid ⟶ nicotinic acid
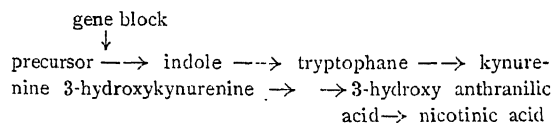
The organism was cultured in Fries' medium as described by Horowitz and Beadle.[10] The organism was allowed to grow in 50 c.c. conical flasks, the total volume of the media being 10 c.c. containing the following substances in the basal medium in mg., ammonium tartrate: 25; $NH_4NO_3$ : 10; $K_2HPO_4$ : 10; $MgSO_4$ : 5; NaCl and $CaCl_2$: 0·1 (each); dextrose: 200; and the following trace elements in gamma, B: 10; Mo: 2·0; Fe: 2·0; and Zn: 20 and vitamin biotin 0·5 milli-microgram. The pH of the medium was 5·6. After 72 hours growth at 30° C., the mycelia were carefully removed, washed, dried at 105° C. and the dried mycelia were weighed in a Roller Smith Torsion balance.

The influence of 21 amino acids added singly to the medium was studied. The following amino acids *l*-leucine, *dl*-isoleucine, *l*-hyroxyproline, *dl*-valine, *dl*-threonine, *dl*-β-phenylalanine, *dl*-methionine, *l*-cysteine, glycine, *l*-tyrosine, *dl*-alanine, *dl*-serine, and β-alanine were found to inhibit the utilisation of tryptophane. The inhibition index varied from 4 to 100, the highly inhibitory amino acids being

*dl*-β-phenylalanine, *l*-leucine, *dl*-methionine, and *l*-cysteine. However, with *l*-tyrosine, *dl*-alanine and *dl*-valine an increase in growth over that of the control, when the amino acids were present in very low amounts was observed. Eight amino acids *l*-proline, *l*-arginine, *dl*-aspartic acid, *l*-histidine, *l*-glutamic acid, *l*-citrulline, *l*-lysine and *dl*-ornithine had no influence when added even upto a level of 2·5 mg. per c.c. of the medium.

From the above observations, it is suggested that certain amino acids inhibit the various enzyme systems which are taking part in the conversion of tryptophane to nicotinic acid. A study of the influence of the various amino acids on the utilisation of other tryptophane metabolites like formylkynurenine, kynurenine, 3-hydroxykynurenine, 3-hydroxy anthranilic acid and nicotinic acid is in progress and will be published in detail elsewhere.

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## ON THE BREEDING HABITS OF THE COWRY *ERRONEA ERRONES* (LINNÉ)*

Cowries are fairly common in the shallow areas of Palk Bay and Gulf of Mannar. The species commonly found in the area between Mandapam Camp and Mandapam has been identified as *Erronea errones* (Linné). Satyamurti[1] records it as also occurring in Pamban, Krusadai and Shingle Islands. Schilder and Schilder[2] have differentiated this species into four geographical races. The species around this region seems to belong to the race *bimaculata* distinguished by features of the aperture of the shell which is narrow behind

and much dilated in front. Ray[3] gives an account of the systematics, habits and habitats, transformation, use, etc., of cowries. Hornell[4,5] and Gravely[6] do not make any mention of the egg mass of cowries and no information is available on the reproduction of Indian cowries.

Lo Bianco[7] was probably the first to describe the egg mass and brood-protecting habit in the genus Cypræa. Vayssière[8,9] besides describing the egg masses of a few species of cowries, gives a small account of a preserved egg mass of *Cypræa errones* of New Caledonia. The few details given by him differ from the present account.

The cowries were found upon the undersurface of the boulders or stones perching over the egg masses with the foot completely extended and covering the egg masses. The animal is quite restless when disturbed while brooding the egg mass. In one instance it was observed that when the adult specimen was completely removed from the egg mass and kept at about 4″ away from it, it crept slowly back to its original position. Breeding was observed from September to April. According to Vayssière, the egg mass of the New Caledonian form is oblong, 11 mm. in length, 8 mm. in breadth and 2-5 mm. in thickness. It is found, however, that in the case of the Indian form the egg mass is nearly circular about 23-26 mm. across, and 8-10 mm. in height at the centre. It was observed that the capsules of these egg masses are deposited in 5-6 layers superimposed upon one another in the form of a cone, the lowest layer being the widest in diameter. The newly laid egg mass is yellowish in colour. It turns gradually brown and ultimately dull purple with the development of the larvæ. The four egg masses examined contained 481, 501, 507 and 517 capsules respectively. According to Vayssière, the capsule of the New Caledonian form contained 20-25 eggs. The number of eggs varies from 30-70 per capsule in the present species. On an average the number of eggs per egg mass will be about 24,500. All of them are potential embryos without nurse eggs.

The capsules are pouch-like and of different sizes and shapes (Figs. 1-4). Each one is provided with a base. Of the 25 capsules examined from different egg masses the length and breadth vary from 1·85-3·25 mm. and 1·35-1·85 mm. respectively. They are horny, glossy and transparent but of pale yellow colour. The larvæ escape through the distal end of the capsule. The eggs are yellowish brown. Vayssière does not give dimensions of the egg

of the New Caledonian species except that the eggs are 14 times bigger than that of *Cyprœa staphylœa*. The newly laid unsegmented egg of the Indian form measures about 0·363–0·367 mm. across (Fig. 5). The newly-laid egg masses
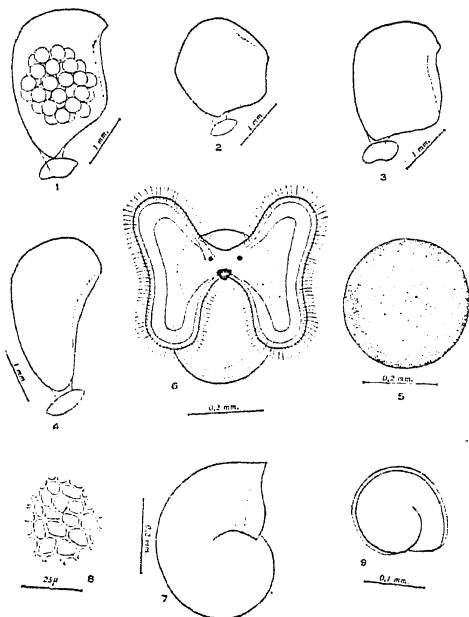


FIGS. (1–4). The egg capsules of different sizes and shapes. FIG. 5. The egg. FIG. 6. The newly hatched Veliger. FIG. 7. The larval shell. FIG. 8. The sculpture of the larval shell. FIG. 9. The Operculum.

kept at the laboratory for observation either show abnormal development or no development at all and hence the exact date of development from the egg to the formation of veligers could not be given. Probably the eggs require the brooding care of the adult specimen until a certain stage of development. An attempt has been made to keep the adult brood-caring specimens at the laboratory in large glass troughs. The animal leaves the egg mass in a day or two at the most. But in the natural habitat the animal continues the brooding till veligers are about to hatch out from the capsules. However, in the egg mass of fairly advanced stages kept at the laboratory the further development was normal and the veligers are formed. Such an egg mass kept at the laboratory on 3rd September 1952 liberated the veligers after 11 days.

The newly hatched veligers measure 0·435–0·473 mm. across the shell (Figs. 6 and 7). The latter is pale brownish in colour with reticulate markings upon it (Fig. 8). The reticulation is only visible under high power and more

or less like that of the larval shell of *Simnia patula* described by Lebour.[10] The extreme tip of the outer lip of the shell is pointed and provides support to the velum. The velum is bilobed and colourless with long cilia bordering the margin. There is a distinct sub-velum with short cilia which lead the food currents towards the mouth. The eyes are distinct but only the right tentacle is present and the left one is not yet developed. The statocysts are not clear in the swimming posture of the larvæ. The foot is very well developed, bears cilia all over it and shows diffuse, black colouration. The operculum (Fig. 9) is colourless and distinct. While swimming the larval shell is either partly or fully surrounded by the mantle. The mouth, œsophagus, stomach and intestine are dark purplish in colour and are distinctly seen through the shell. The heart beat is clearly visible. The liver is yellowish and appears pressed against the stomach.

The larva has been kept alive at the laboratory for about 5 days. No visible changes were noticed during the time and it is probable that the larval period is of long duration. The larva at this stage of development is quite common in plankton collections from Palk Bay between September and April.

I am indebted to Dr. N. Kesava Panikkar for his guidance and encouragement.

Central Marine Fisheries     A. V. NATARAJAN.
Res. Station,
Mandapam Camp, *March* 30, 1954.

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# MATING REACTIONS IN THE COMMON INDIAN HOUSEFLY, *MUSCA DOMESTICA* NEBULO (FABRICIUS)

THE male and the female of the common Indian housefly, *Musca domestica* nebulo (F.) are easily distinguished from each other by external characters, and are therefore suitable for a study of their mating behaviour.

Male and female flies of the same age were selected in a particular ratio (30 males to 6 females). The cage containing them was kept under observation in different months, continuously for 12 hours of the day, beginning from 6·30 a.m. onwards. The number of mating reactions per half hour was plotted over the whole observation period. Temperature, relative humidity, and light intensity were recorded in each case.

Figs. 1 and 2 show clearly that houseflies of this species show a distinct *diurnal mating*
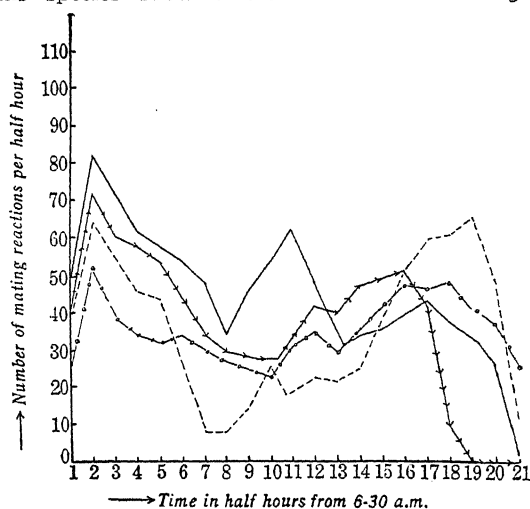


FIG. 1. Diurnal Mating Rhythm in the months of June, July, August and September: Broken line–June, Straight line–July, Line with circles–August, Line with arrows–September.

*rhythm.* Two peaks of mating activity were observed, one in the morning and the second in the afternoon, the exact time of each peak differing slightly for the different months. While a diurnal rhythm has been described for the activities of several other arthropods[1-3], as far as we know, no diurnal mating rhythm has been recorded in houseflies by any previous worker.

The effect of light on this mating rhythm was specially studied, by subjecting the flies to "reversed illumination", *i.e.,* keeping them in darkness during the day and under artificial illumination during the night. Under these conditions all activities of the flies ceased during the day. The intensity of illumination produced in two different cages, in which the mating reactions of the flies were studied simultaneously, was made 200 foot-candles for the first, and 75 foot-candles for the second cage, by keeping them at different distances from several (fluorescent) light sources in a dark room
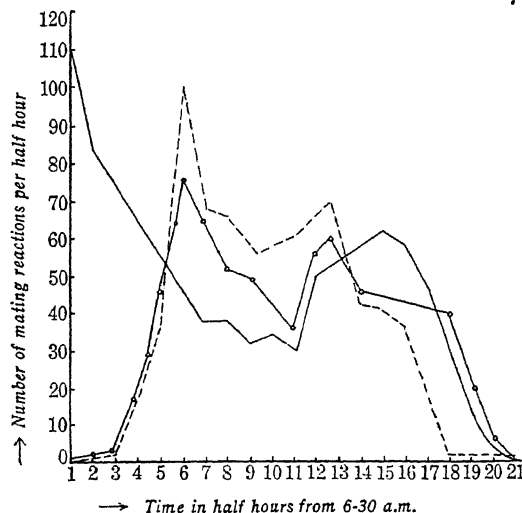


FIG. 2. Diurnal Mating Rhythm in the months of October, November and December : Straight line—October, Broken line—November, Line with circle—December.

throughout the night. The mating reactions thus observed, were recorded in two different curves in which the number of reactions was plotted against the time of observation. It is quite evident from these two curves (Fig. 3) that (*a*) at 75 foot-candles a reversal of the
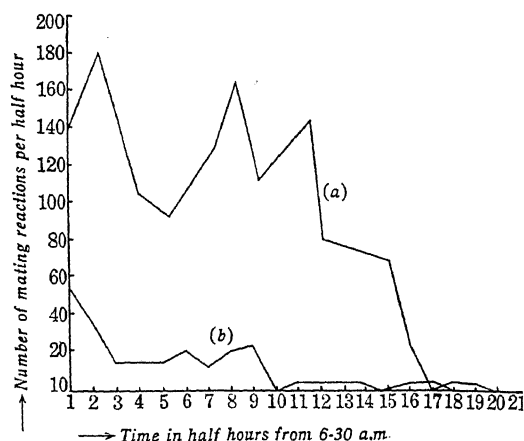


FIG. 3. Effect of the Intensity of Light on the Mating Rhythm: Cage (*a*) exposed to 75 ft. candles, Cage (*b*) exposed to 200 ft. candles during the night.

normal rhythm was observed, in so far as the usual mating rhythm with its two characteristic peaks, now appeared during the night; and that (b) in the stronger illumination, mating reactions were inhibited to such an extent that the usual rhythm was suppressed. Thus, darkness, as well as very strong illumination, will upset the normal mating rhythm of the housefly. Work on the effect of other factors like temperature and relative humidity on this rhythm is now in progress.

The mating reaction has also been analysed with reference to the stimuli emitted from the female which are essential for eliciting a response in the male. Contrary to the assumption made by most authors, olfactory stimuli were found to play a very minor part, if any. A dummy made of wool, roughly corresponding to a female housefly as regards the visual stimuli of size, shape and relative brightness (luminance) is sufficient not only to attract any amount of males from a distance but even to elicit a typical mating response at close quarters, including the "jump" on to the "back" of the dummy, which is the most characteristic phase of the normal mating reaction in both *M. domestica* and *M. domestica* nebulo.[4,5] This behaviour is similar to that observed by the senior author in *M. domestica* on dummies.[6] "Queen cages" of wood with wire-netting covers, containing female flies, which were thus made invisible to the males but could be smelt, failed, on the other hand, to attract the males to any greater extent than did similar cages containing male flies, or no flies at all. This result suggests that, under the condition of the experiment, the olfactory stimuli emitted by female houseflies were not sufficient in themselves to attract the male housefly, let alone to elicit any phase of its characteristic mating response.

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University of Poona,    L. MULHERKAR.
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*March* 15, 1954.

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## REPORT ON *BIDDULPHIA TUOMEYI* (BAIL.) ROPER—A DIATOM NEW TO INDIA

So far, eight species of *Biddulphia* have been recorded from India, from the Madras and the Travancore coasts, viz., *B. pulchella* Gray, *B. sinensis* Grev., *B. mobiliensis* Bailey, *B. heteroceros* Grun., *B. rhombus* (Ehr.) W. Sm., *B. longicruris* Grev., *B. regia* Schulze, and *B. granulata* Roper.[11,12,14] In my collection of diatoms from the Chilka Lake (lat., 19° 28' and 19° 54' N.; long., 85° 6' and 85° 35' E.), I came across a species of *Biddulphia* which does not appear to have been reported earlier from India. Opportunity is, therefore, taken in this communication, to record this species from this region.

The following is a short description of the Chilka diatom: Frustule in girdle face with deep constrictions, dividing the valve face into three median mammiloid elevations or lobes; lobes beset with short spines, the middle lobe being considerably larger than the two lateral ones and with one or two long spines at its summit, measuring about $11\cdot2\,\mu$ in length. Valve at the poles of the apical axis drawn out into well developed processes. Process inflated both
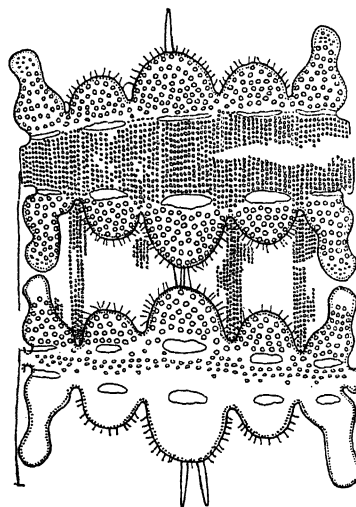


FIG. 1. *Biddulphia tuomeyi* (Bail.) Roper, girdle view, × 430.

at base and apex and somewhat reflexed, extending farther than the mammiloid elevations, and twice the length of the adjacent and about 1/3 longer than the central lobe. Cell-wall areolate, areolation circular, larger and in radial or concentric lines on the lobes, finer and in parallel rows on the connecting membrane

and girdle. The areolæ at the tips of processes much finer than those at their bases. Apical axis, $105 \cdot 6 \mu$; pervalvar axis $54 \cdot 4 \mu$ and at the poles $57 \cdot 6$-$60 \cdot 8 \mu$. Areolæ in valves, 4-5 in $10 \mu$, and in the connecting membrane, and girdle, 7-9 in $10 \mu$ (Figs. 1 and 2).
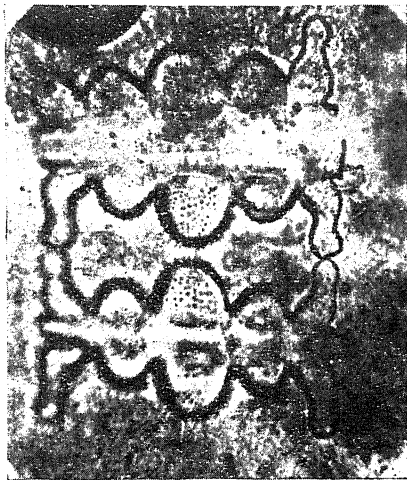


FIG. 2

FIG. 2. Photomicrograph of *Biddulphia tuomeyi* (Bail.) Roper, $\times$ 380.

*Habitat.*—Chilka Lake—planktonic, in the outer channel. Extremely rare. April 1950.
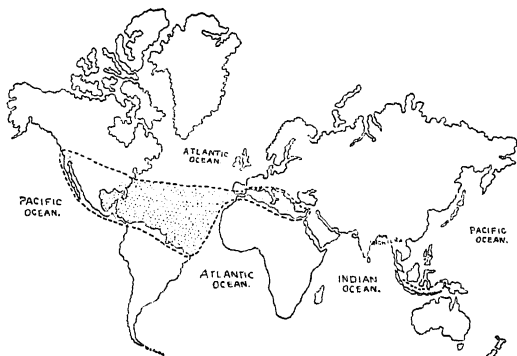


FIG. 3. Map showing the world distribution of *Biddulphia tuomeyi* (Bail.) Roper (shaded portion).

The present diatom agrees well with the species *Biddulphia tuomeyi* (Bail.) Roper, in its general characters (*cf.* also Figs. of Bailey,[2] Pl. III, Figs. 3 and 4; Castracane,[4] Pl. XXVI, Fig. 10; Hustedt,[10] Fig. 491; Roper,[13] Tab. 1, Figs. 1 and 2; van Heurck,[16] Pl. XXXIV, Fig. 895; Williamson,[17] Fig. 1).

Apparently widely distributed in the warmer seas, in the American waters (common along the S. Atlantic coast of N. America, St. Augustine, Bermuda, Virgin Isls., and Natal in S. America), in the Mediterranean (west coast of Italy, Naples, Corsica, North Adriatic), and in a few stations in and about Indonesia (Sumatra, Bali-sound, Banda sea and Dutch New Guinea, and possibly also extending into the Pacific), and also occurring as fossil in the Miocene deposits of California, in the siliceous infusorial marls of Piscatoway (Maryland) and Petersburg (Virginia) and New Jersey in N. America, in Levant Mud, and in Hungary in Europe (Fig. 3), the extension of records of this species to the Indian region, from where it has not been known earlier, is of considerable interest. Further, the previous records indicate for the species a pelagic habitat or a fossil state. The present diatom was, however, collected from an estuarine area at the outer channel of the Chilka Lake, a few miles distant from the mouth of the lake proper.

Curator, Industrial Section,   K. S. SRINIVASAN.
Indian Museum, Calcutta,
*November 2, 1953.*

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## *PIRICULARIA* SPECIES ON *SETARIA INTERMEDIA*, ROEM AND SCHULT

*Piricularia oryzæ* has been reported as infecting *Oryza sativa, Oryza cubensis* Kawamura,[1] a number of cultivated cereals and also certain wild grasses. Amo̅ the cultivated cereals, the suscepts far reported are: *Eleusine coracana, ͨ italica, Triticum vulgare, Hordeum vulga*

*Secale cereale* Padwick.[2] It has also been reported on the following wild grasses: *Panicum miliaceum* Simonds,[3] *Panicum repens* Thomas,[4] *Panicum ramosum* Butler and Bisby,[5] *Digitaria marginata* Ramkrishnan,[6] and *Dactylotenium ægyptiacum* Thomas.[4]

The authors in 1953 Abi[*] at Kalvakurthi village in Mahboobnagar District found *Setaria intermedia* to be freely growing on the bunds of a rice seed farm wherein HR.35 was transplanted. The lamina of *Setaria intermedia* showed lesions closely resembling blast. The specimens were, therefore, brought to the laboratory at Himayetsagar and carefully examined.

The lesions on the lamina of *Setaria intermedia* were 3·8 mm. long and 1·9 mm. wide. They had a dull greyish appearance in the centre and the outer rim was dark brown. In the case of severely infected plants, the centre of the lesions was almost straw-coloured. Scrapings from the lesions were examined. Conidia that were biseptate, piriform, with round base and narrowed apex almost hyaline to pale olive were found. They measured $21·96-29·28 \times 8·88-10·98 \mu$. The corresponding measurements of spores of *Piricularia oryzæ* are $14-40 \times 6-13 \mu$. *Setaria intermedia* may, therefore, probably be a host of *Piricularia oryzæ* subject to cross-inoculation test.

It may be mentioned that stray plants of HR.35 from the seed farm bore similar lesions though the incidence was comparatively less. On examination, blast spores were detected from the lesions also. *A priori*, it is difficult to say whether the paddy infected the wild grass or *vice versa*. Cross-inoculation studies are being made.

The authors wish to acknowledge the help rendered by the Plant Pathologist, Himayetsagar, Hyderabad.

Agril. Expt. Station,      M. S. Pawar.
Himayetsagar, Hyderabad,      S. A. Kulkarni.
*April* 12, 1954.

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## MASS ASSEMBLAGE OF THE COCCINELLID BEETLE, *EPILACHNA BISQUADRIPUNCTATA* (GYLLENHAL) IN CHOTA NAGPUR

ALTHOUGH several interesting cases of mass assemblage of ladybird beetles are known from America, Europe, Russia and Africa, only two such cases have hitherto been recorded from the Indian region, namely, that of the fungivorous species, *Thea bisoctonotata* Mulsant, which was observed by the author[1] in a great congregation on a tree in Model Town, Lahore, in the winter of 1936, and of *Coccinella septempunctata* Linn. very recently observed by Mani[2] on the glacier beds at the Lakka pass (15,000′) in Dholpur Range in the Western Himalayas.

During February 1954, while on a collecting tour with the Zoological Survey of India party in Chota Nagpur, Bihar, the author came across several congregations of a small (4–5 mm. long) herbivorous coccinellid, *Epilachna bisquadripunctata* (Gyllenhal), at Chatra (*ca.* 1,400′) District, Hazaribagh. The congregations were observed in the vicinity of a small stream called Hiru which passed through a thinly wooded area, about 1½ miles south of Chatra dak bungalow. The stream was mostly dry at the time of the visit but here and there a number of small pools, connected by slow-moving water, were present. Along the banks and on the rocks which formed small islands, there was a fairly dense growth of nearly 2′ tall grass (*Eleusine* sp.). It was near the base of the grass and on the ground between the plants that the beetles had congregated. These could not be spotted from a distance but were easily located when the grass was parted with hands. Within an area of about a thousand square yards, four different congregations were observed. The smallest congregation was spread over a piece of ground about 9″ long and 6″ wide. From the sample count in the field it appeared that this lot alone must have contained some three to four thousand beetles. The largest assemblage observed in the area covered a ground which was nearly 4′ long and 2½′ wide. The beetles were lying almost closely packed and over one another. In each assemblage the depth of the mass of beetles varied from 2″–4″ as judged by thrusting a pencil through it. Obviously the beetles were in a resting state as they did not move when disturbed. Most Coccinellidæ simulate death when disturbed but become active after a short time. In the present case they remained inactive throughout; even when disturbed persistently or shaken, they moved

only reluctantly and exuded the yellow fluid characteristic of the family. In no case did they take to flight though they had well-developed membranous wings.

The grass as well as other plants in the vicinity were also examined but these did not show any sign of attack by the lady-bird beetles. Generally it is easy to find out whether or not a herbivorous lady-bird beetle has fed on a certain plant because the beetles leave characteristic markings on the host plant. When a handful of them were brought for further observations in the laboratory, they continued to remain in the resting state and did not accept any food including the grass on which they were collected. A large number of them were dissected but their stomachs were found to be almost empty and without any trace of greenish plant tissue or juices. The abdomen of each, irrespective of its sex, was found to be full of stored fatty bodies and suggested that the beetles were not starved but were in a peculiar physiological state. The sexes were equally represented and the females did not show any advanced stage of development of the ovaries.

The significance of the phenomenon of mass assemblage in Coccinellidæ is little understood. Various explanations such as lack of food, the urge to seek more equitable temperature or be attracted by a peculiar smell or the opposite sex (with a view to ensure maximum fertilization) have been suggested. Others have considered it to be purely of physiological origin and not a result of lack of food or similar conditions. The present observations seem to support the latter view but further records and detailed observations would no doubt be necessary for a fuller explanation of the phenomenon as occurring in India. Such records would also be useful from the economic point of view. In the case of herbivorous species, some of which are notorious pests, the assembled beetles may be easily collected and destroyed as is done in Persia with the 'sun' bug, *Eurygaster integriceps*, which has a similar habit of congregating in masses.[3] On the other hand, if the species of assembled coccinellids are beneficial, these could be collected in large quantities from one place and taken to another for liberation into the fields infested with such pests as would form the food of the lady-bird beetles. The latter practice is followed in the mountains and valleys of the Western United States with regard to the Coccinellid *Hippodamia* which feeds on aphids or plant-lice.[4] A few species of *Hippodamia* and of the related genus *Adonia* occur in the

Himalayas and it would be valuable to know if any species of these genera assemble in masses in that region.

Zoological Survey of India,     A. P. KAPUR.
Calcutta, *April* 12, 1954.

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## CROSSES BETWEEN *BRACON HEBETOR* SAY AND *BRACON BREVICORNIS* WESM. (BRACONIDAE, HYMENOPTERA

THAT there exists some confusion with regard to the identity of the two allied braconids, *Bracon hebetor* Say and *B. brevicornis* Wesm., is evident from a perusal of literature. Detailed examinations of hundreds of specimens of the two species were made for the various morphological characters including genitalia. In addition, attempts were also made at crossing the one species with the other, with a view to establish whether the two species are the same or distinct, and the results are reported here briefly.

*Bracon hebetor* specimens obtained from pure cultures in the laboratory here, and *B. brevicornis* obtained from I.A.R.I., Delhi, through the kind courtesy of Dr. E. S. Narayanan were used in these experiments. Care was taken to see that males and females of both species were separated as they emerged from pupæ. Unmated males and females of *B. hebetor* were enclosed separately along with the individuals of opposite sex of unmated *B. brevicornis* in $3'' \times 1''$ glass vials for about 24 hours to allow time for mating. Then each lot was enclosed in a separate petri dish containing half- to full-grown larvæ of the rice moth, *Corcyra cephalonica* Staint. Egg-laying by the females, larval and pupal development and finally cocoon-formation of the progenies were found to be normal as in the case of *B. hebetor,* or *B. brevicornis*. Progenies of both series of crosses, namely, *B. hebetor* ♀ × *B. brevicornis* ♂ and *B. brevicornis* ♀ × *B. hebetor* ♂ were found to be fertile both when inbred and crossed with pure *hebetor* or *brevicornis*.

The details of these studies together with those on morphological characters to establish the identity of the two species are being published elsewhere.

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## THE EMBRYO SAC OF *OCHNA SQUARROSA* LINN.

EMBRYOLOGICAL investigations on the family Ochnaceæ have been very little. Schnarf[1] has briefly reviewed the earlier literature on the embryology of a few species of *Ochna*. In the present note an account of the development of female gametophyte of *Ochna squarrosa* is recorded.

The superior apocarpous gynœcium consists of 8-10 carpels, each of which has an anatropous, bitegmic and crassinucellate ovule. A hypodermal archesporial cell gets differentiated just when the integumental initials are laid down (Fig. 1). It soon enlarges and directly



FIG. 1. Portion of nucellus with archesporium, × 970.
FIG. 2. Same at a later stage, × 970.
FIG. 3. Stage showing degenerating and functional megaspores, × 970.
FIG. 4. Four-nucleate embryo sac with degenerated megaspores, × 970.
FIG. 5. Mature embryo sac with its complements, × 679.

functions as the megaspore mother cell (Fig. 2). After the usual meiotic divisions, the megaspore mother cell gives rise to a linear tetrad of megaspores. Of the four megaspores the upper three degenerate and the lowermost develops into the embryo sac (Fig. 3). In the functional megaspore vacuoles make their appearance (Fig. 3). The functional megaspore, during its enlargement, destroys the adjacent nucellar cells (Fig. 3). Its nucleus divides once to form two nuclei which move to the opposite poles by the development of a central vacuole. After two more divisions an eight-nucleate embryo sac of the Polygonum type is formed (Figs. 4, 5).

In the mature embryo sac the egg apparatus consists of two synergids and an egg (Fig. 5). The synergids show 'filiform apparatus'. The secondary nucleus lies usually near the egg apparatus. The antipodals are very large and their nuclei become hypertrophied (Fig. 5). A detailed account on the embryology of *Ochna squarrosa* will be published elsewhere.

Lingaraj College,   P. S. CHIKKANNIAH.
Belgaum, *May* 29, 1954.

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## TREATMENT OF ROOT TIPS IN PHENOL FOR THE STUDY OF KARYOTYPE

LEVAN AND TJIO[1,2,5] have shown that a large number of chemicals possess the property of inducing chromosome fragmentation.

The present investigation on the study of karyotype is concerned principally with different types of phenols, the fragmentating property of which has been well worked out by Levan and Tjio.[2]

Of all the phenols tested till now, namely, phloroglucinol, resorcinol, hydroquinone, pyrogallol and guaiacol, the first yielded the best results. It may be added that all of them excepting the last one are effective in different degrees in bringing about chromosome structure in details.

The optimal values of the concentrations needed for bringing out the chromosome details have always been found to be lower than the one required for causing extensive fragmentation. The picture revealed looks more or less the same as obtained after oxyquinoline[3,6] and coumarin[4] treatments.
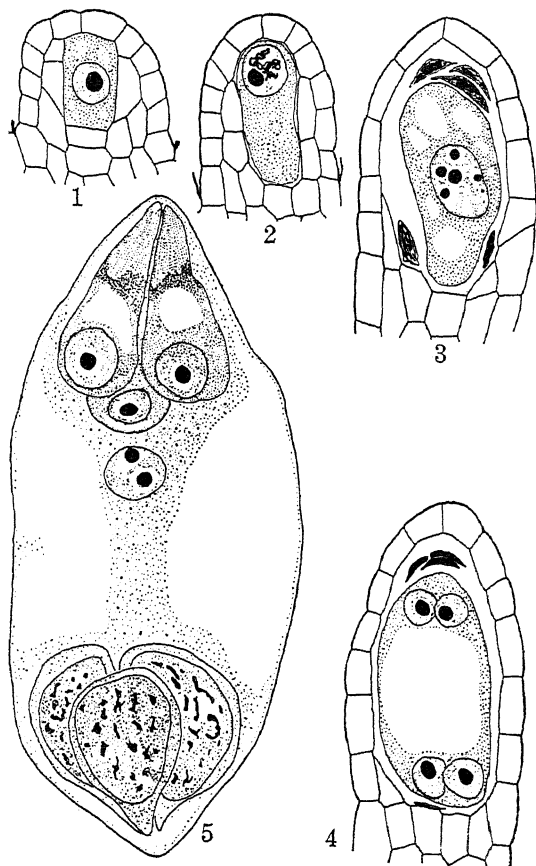
The procedure followed consists in treating the freshly cut root-tips in ·001-·005 M aqueous solution of phloroglucinol for 2½-3 hours at a temperature of 10-15° C. followed by heating till incipient boiling in a mixture of 2 per cent. aceto-orcein and NHCl (in the proportion of 9 : 1) for 5-6 seconds. The material after being sufficiently softened can be smeared in 1 per cent. aceto-orcein solution by applying uniform and heavy pressure over the cover glass with the help of filter-paper put on it. The slides thus prepared can be kept for at least a week by proper sealing and using a moist chamber.
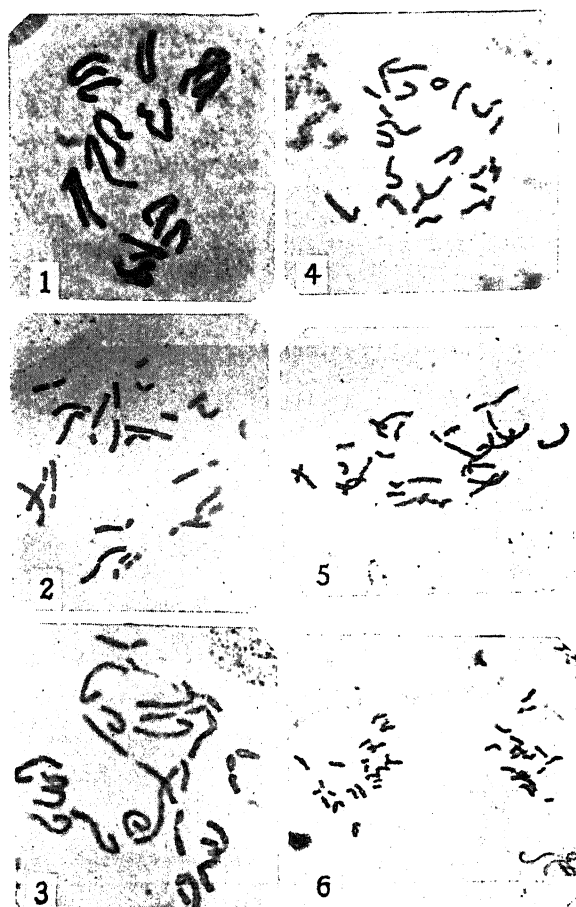


Explanation of photomicrographs from Phloroglucinol-treated cells :—

FIGS. 1—3. Prophase and metaphase stages respectively of *Crinum* sp. showing the condensation in prophase, exaggerated constrictions in metaphase and granulated appearance after prolonged treatment.

FIGS. 4—6. Metaphase and anaphase stages of *Hydrilla* sp., the centromeric granules in Fig. 5 and the spread apart appearance in anaphase in Fig. 6 is to be noted. Magnification, × 900 (approx.)

Viscosity changes of the cytoplasm seem to be brought about by this chemical as worked out in case of oxyquinoline (*vide* Appendix by Stålfelt in Tjio and Levan's paper[6]), and sufficiently spread out metaphase plate, manifesting the chromosome morphology to the minute details, in a single plane (Figs. 2 and 4) can easily be obtained. Contractions of chromosome arms manifested in various degrees in different segments result in a pronounced appearance of the constriction regions, both primary and secondary. The centromeric granules noted by Tjio and Levan[6] after oxyquinoline treatment can also be brought about after this procedure (Fig. 5). The secondary constriction regions become unusually pronounced in some cases. The manifestation of secondary constriction regions thus exhibited in a different way from the rest of the chromosome parts may possibly be attributed to its differentiated nature, both chemical and physical, from any of the chromosome segments. Ample data on this aspect has recently been gathered in our laboratory which will be published shortly.

Prophase stages too show considerable contraction of the chromosome arms thus facilitating the study of chromosome morphology even at this stage (Fig. 1). Spiral structure of chromosomes are revealed in some of the plates (Fig. 5) and even anaphase (Fig. 6)—the later stage shows well scattered chromosomes. With slightly higher concentrations, granulated structure in chromosome segments in late prophase can be noted (Fig. 3).

A detailed report of the work would be published elsewhere.

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## PHOTOPERIODIC RESPONSE IN EARLY VARIETIES OF RICE

THE photoperiodic response of the different varieties or strains of rice growing in various localities of India is greatly varietal in character.[1-8] The present investigation is aimed at finding out the photoperiodic response of two early varieties T.N. 32 (from Baljati of Lucknow

District) and T.A. 64 (from Hansharaj of Unnab District) of Uttar Pradesh. When the seedlings of these varieties were 10, 20, 30, 40 and 50 days old respectively, they were subjected to 10-hour short days (8-00 a.m. to 6-00 p.m.) for a month whereas in other sets of seedlings of the same age groups the same short-day treatment was prolonged till ear emergence. The time taken from sowing to ear emergence of the main shoot under the different short-day treatments is graphically presented in Fig. 1. Short-day photoperiod



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brings about a delaying effect in the first panicle emergence in both the varieties. The delay is the greatest when the treatment is applied to the seedlings of 10 days old. As the treatment is commenced with older seedlings of 20, 30, 40 and 50 days there is a gradual lessening of the delaying effect. At every increase of 10 days in the age of the seedling at the time of commencement of the treatment there is a decrease in the mean time of heading by 2·56 days in the range of 10-50 days which is under consideration. Further, the time taken for flowering in the series where the short-day photoperiod is given till the emergence of ears, is always longer than the other series where the photoperiod is limited to a month, irrespective of the age of treated seedlings but the difference seems to be much less when the age of the treated seedlings gets more and more advanced. The two varieties do not give significantly different response.

Grateful thanks are due to Prof. Shri Ranjan for his helpful suggestions and guidance and the facilities provided by him in the Botanical Laboratory of the University of Allahabad for carrying out this piece of investigation and to my colleague, Mr. C. M. Bastia, for the diagram.

## SWEET POTATO AS A NEW HOST PLANT FOR THE WEEVIL, *ALCIDODES FABRICII*, FABRICIUS

THE weevil, *Alcidodes fabricii* Fabricius, has been recorded on a number of plants in South India.[1-4] In the course of the field studies on the common weevil pest of sweet potato *Ipomœa batatas*, Lam.), namely, *Cylas formicarius*, Fab. the author came across a number of specimens of the Weevil, *Alcidodes fabricii* Fab., on sweet potato crop at Coimbatore. On
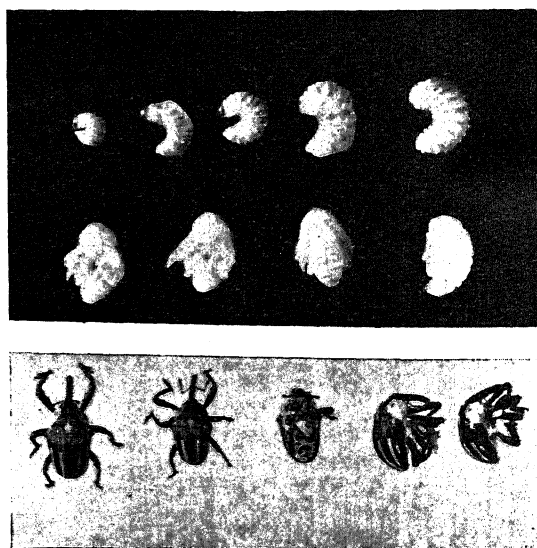


FIG. 1. Stages of the weevil *Alcidodes fabricii*, Fabricius.

closer examination, the weevil was found actually breeding inside the capsules of the crop. All the stages of the weevil, were found inside the fruits. This is probably the first time that this weevil is noted on sweet potato crop.

The adult weevil is a medium-sized reddish brown beetle with four longitudinal creamy

stripes on the elytra. Eggs are inserted at the base of the fruit on the stalk and the grubs that hatch out bore from the bottom portion of the fruit and feed on the seeds inside. Pupation takes place inside the capsule itself and the adult weevil emerges out through a hole on the side. Only one grub has been noted in each capsule. The attack is not easily visible from outside as the grubs bore from the bottom and it can be made out only by the small puncture on the stalk of the fruit made by the weevil during oviposition. The adult feeds on flowers. The weevil was noted in larger numbers in some of the seedling types of sweet potato, namely I.B. 22, 52, 54 and 55 than in the local one, since the above varieties flower profusely and set fruits. The detailed study on the biology of this weevil is in progress.

Agricultural College &     T. R. Subramaniam.
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## THE TEMPORAL REGION IN THE SKULL OF *CHAMAELEON-ZEYLANI-CUS*-LAURENTI

It has been now generally accepted that lizards are the modern representatives of the *parapsidian* skull; but since they are on the ladder of 'ascent' their course of evolution is marked by either the appearance or the abortion of one or more fossæ. *Chamæleon zeylanicus* offers a classic example along this line.
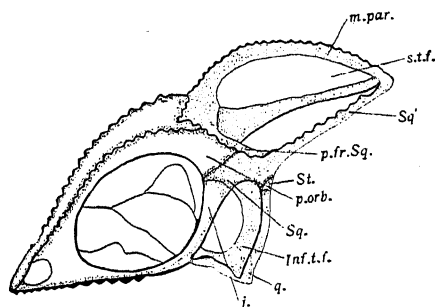


FIG. 1. Lateral view of the skull of *Chamæleon zeylanicus* Laurenti × 3.

The mode of the formation of the post-temporal vacuity (foramen retro-temporalis of Siebenrock[1]) in chamæleons is quite different from other lacertilians. In *Chamæleon zeylanicus*, though the supra-temporal arcade is much elongated, yet only its beginning part contributes in the formation of the union of the distal end of the *para*-occipital process near the *Condylus cephalicus* of the quadrate and the obliquely directed lateral ridge of the supra-occipital and that such a vacuity is embedded within the supra-temporal vacuity. Thus the position of the post-temporal vacuity is peculiar and perhaps, hitherto unparalleled in the lacertilian studies. The post-temporal fossa is surrounded by the ex-occipital posteriorly, the supra-occipital and the squamosal laterally and the parietal anteriorly. There is no separate post-temporal arcade as for the absence of processus-parietalis here. Although its other constituents, the supra-temporal and the squamosal are present as in other lizards.
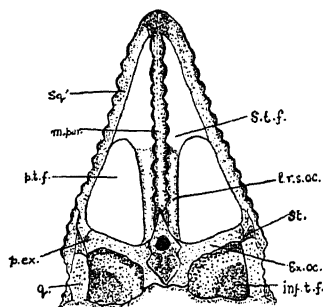


FIG. 2. Posterior view of the skull of *Chamæleon zeylanicus* Laurenti × 4.

*Ex.oc.*—Ex-occipital. *inf.t.f.*—Infra temporal fossa, *j.*—Jugal, *l.r.s.oc.*—Lateral ridge of the supra-occipital; *m.par.*—Median process of the parietal, *p.ex.*—Para-occipital process of ex-occipital; *p.fr.sq.*—Post fronto squamosal, *p.orb.*—Post orbital, *q.*—Quadrate, *S.t.f.*—Supra-temporal fossa, *St.*—Supra-temporal ; *Sq.*—Squamosal, *Sq'*.—Squamosal extension.

The jugal and the quadrate are widely separated from each other and hence the lower temporal arcade or the infra-temporal arcade atrophies in *Chamæleon* by the loss of the quadrato-jugal, as in rest of the lizards. The infra-temporal vacuity, however, is very large bounded above by the supra-temporal arcade and posteriorly by the quadrate. It is separated from the orbit by an extension of the post-orbital and by the jugal. As the infra-temporal arcade is missing the infra-temporal fossa has no limit below and opens freely.

The presence of a single temporal arcade (supra-temporal arcade) among the three temporal fossæ is worth recording.

I am greatly indebted to Dr. P. N. Mathur for his kind guidance, Principal V. V. John for full facilities and to the Government of India for the award of a scholarship.

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*March* 2 1954.

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## THE DIPOLE MOMENT OF INDENE

THE dipole moment of indene is determined in three non-polar solvents—cyclohexane, carbon tetrachloride and carbon disulphide—covering a dielectric constant range of about 2·0-2·6. The dielectric constants of the solutions are determined at a frequency of 3·6 Mcs./Sec. using the heterodyne beat method and a modified dielectric cell of the Sayce and Briscoe type.[1] The experimental observations are treated in the manner discussed by Guggenheim[2] for obtaining the dipole moment values. The results are given in the following table.

TABLE I

*Temperature* $= 31 \cdot 5°$ C.

| Solvent | Dielectric constant of solvent | $P_0$ c.c. | Dipole moment in Debye units |
|---|---|---|---|
| Cyclohexane | 2·0076 | 14·08 | 0·84 |
| Carbon tetrachloride | 2·2215 | 14·52 | 0·85 |
| Carbon disulphide | 2·6212 | 15·79 | 0·89 |

It is noted that the orientation polarisation $P_0$ and hence also the dipole moment increase as the dielectric constant of the medium increases. That is, the compound exhibits a positive solvent effect.

A detailed report of the investigation will be published elsewhere.

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Andhra University,
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## SYMPOSIUM ON THE CONTROL OF INSECT VECTORS OF DISEASE

THE reliance placed on chemicals during the past decade in the fight against insect vectors of disease and the failure of some of the commonly used insecticides to maintain control of certain species have given rise to complex problems. The nature and significance of these appeared to justify a broad review by a group of experts in order to formulate, so far as was possible, both immediate and long-term plans. In consequence, a symposium on the control of insect vectors of diseases was convened in Europe jointly by the Regional Office for Europe of the World Health Organization and the Instituto Superiore di Sanita, Rome, in October 1953, and was attended by 24 experts from 11 countries with a wide geographical distribution.

Among the suggestions for future orientation of insect-control programmes, the need for basic physiological research on insect resistance was particularly emphasised during the symposium. The areas in which the greatest amount of research appears to be required are the following: (*a*) *General Research*: Expansion of basic research on the physiological mechanisms of intoxication and death for all insecticides in widespread use, development of the necessary microanalytical methods for determining insecticides and their metabolic derivatives in insect tissues, identification and detailed analysis of resistance mechanisms, development of the physiological basis for alternative methods of controlling resistant insects. (*b*) *Specific Laboratory Research*: Studies of the manner in which systemic insecticides are metabolized by the insect body to produce toxic products, studies of how and where DDT is stored in the tissues, development of synergists for protection of new and known insecticides against metabolic breakdown, development of improved insecticides from those groups of compounds (*e.g.*, organic phosphates, pyrethrins and analogues) resistance to which seems to be less readily developed. (*c*) *Specific Field Research*: A survey should be made, in all areas where adequate laboratory facilities are available, of the ability of available strains of Musca to absorb and metabolise DDT, the purpose being to gain an understanding of the relative importance of absorption and metabolism in DDT resistance.

# REVIEWS

Advanced Statistical Methods in Biometric Research. By C. Radhakrishna Rao. (John Wiley & Sons), 1952. Pp. xvii + 390. Price £ 3.

The core of this book is its exposition of Mahalanobis' $D^2$ and of developments of the theory made by Rao himself, which have hitherto been accessible only in published papers. This is contained in the main in the last three of the nine chapters.

In the earlier chapters (Chapters 2 to 7), other statistical methods, derived largely from the work of W. S. Gosset and R. A. Fisher, are expounded with admirable succinctness.

Chapter 1 is a purely mathematical introduction to matrices and quadratic forms. It is a short but clear and useful introduction to the theory, for purposes other than its applications to statistical work. The second chapter brings together a number of classical theorems on the normal distribution of a number of correlated variates, and related distributions. It is a useful work of reference for those who have a good grounding in the subject already.

The section on linear estimation gives a very concise treatment of the formation of normal equations, with extensions suggested by R. C. Bose, and developed by Rao himself in his papers in *Sankhya* in 1945. The methods of maximum likelihood, analysis of variance, the use of $\chi^2$, Student's $t$, the variance-ratio $F$, Neyman and Pearson's likelihood test, are dealt with concisely and with a fair number of numerical examples. There are places in the book (for example, in the discussion of tests of independence and of the uses of $\chi^2$ in Chapters 5 and 6 where a number of methods are mentioned with little discussion : but there are adequate references to the literature).

The numerical illustrations are largely (as the title suggests) from biometric measurements ; but the methods can be applied to classificatory problems in other fields. There is fairly full discussion of the data in the anthropometric survey of the U.P. contained in the classical paper by Mahalanobis, Majumdar and Rao, in *Sankhya* in 1949, to which Rao contributed the main mathematical parts.

The book is by no means easy reading. Terms and symbols are introduced in a way which will be understood by one familiar with the subject, but must be difficult for a new reader. In some cases, a symbol or a phrase is used but not explained until a little later in the book. The book would gain in value as a general work of reference, and might be suitable at an earlier stage in the study of statistical theory, if there were a table of signs and symbols used. There are a dozen symbols commonly used in the book, but not found in the index.

That Mahalanobis' $D^2$ and Hotelling's $T$ are effectively equivalent is made clear on pages 73 and 74 of the book, but elsewhere they are discussed in separate sections—which must add to the difficulties of the student.

As Mahalanobis' generalised distant function is so prominent a feature of the book, it is odd to be told (on p. 355) that it is applicable only to groups in which the measurements are normally distributed. Surely, the generalised distance can be used with considerable confidence in many problems where the distribution is known not to be normal ; although (as in so many other cases) the theory has been fully worked out only for the normal distribution.

It may seem cavilling, when a book is as a whole so very well printed, to complain about punctuation ; but Rao's indifference to punctuation—its total absence from equations—does occasionally leave the meaning of a sentence ambiguous. Among many good printers today, it is the fashion perhaps to use much less punctuation than formerly ; and no doubt if the necessary effects can be obtained by spacing, the page will gain in elegance and the exposition in clarity, but in this book the omission or insertion of punctuation is careless : quite often a full stop occurs where a sentence does not end ; some commas appear between the factors of a continued product.

Rao's published papers combine a thorough discussion of the abstract logic of statistical methods with descriptions of the mechanical computing programmes necessary for those methods. This unusual quality—for it is a remarkable gift to be able, not only to show what on logical grounds ought to be done, but also how in actual computation it can be done —is abundantly in evidence here also. Even in the first—purely mathematical—chapter there is a description of a computing tech-

nique for calculating a reciprocal matrix. But this high standard of thoroughness has some lapses : for example, we are told (on p. 338) that the problem of finding the best method of the selection of candidates for a number of jobs, on the basis of their scores in some suitably designed tests, admit a neat solution by the use of lemmas in an appendix ; but the lemmas depend on the existence of a set of constants whose existence is not proved.

The volume is sure to be widely used not only by those interested in biometric research, but also by a much wider class of statisticians.

W. F. KIBBLE.

**Infra Red Absorption Spectra of Steroids—An Atlas.** By K. Dobriner, E. R. Katzellinbogen and R. N. Jones. (Interscience Publishers, New York), 1953. Pp. 299. Price $ 11.50.

In recent years, increasing use has been made of the infra red absorption spectrum in general chemical analysis. In the field of steroids, in particular, the infra red spectrum has been used for the purpose of identification and for eliciting information about the functional groups present in a steroid. No two steroids excluding optical isomers, give exactly the same spectrum, and this fact serves as the basis for the use of infra red spectroscopy as a means of identifying steroids. Research workers are often greatly handicapped by the scarcity of published spectra of pure compounds, and the present book takes a great step forward in overcoming this difficulty in the case of steroid hormones, their metabolites and derivatives, steroid alcohols, bile acid esters, steroid sapogenins, cardiac aglycones and steroid alkaloids, by providing a compilation of infra red spectra of about 300 compounds of this class.

The spectra are arranged according to the presence in the compound of groups giving characteristic absorption so as to facilitate comparison of the appropriate spectra with that of an unknown steroid. A short introduction to the book describes the use of the spectra as a method of identification and also includes a discussion of the correlation of absorption frequencies with various structural characteristics. The book contains a bibliography of 48 references to practically all the available literature on the subject.

The spectra, indexed both numerically and alphabetically, have been obtained in solutions in carbon tetrachloride, carbon disulphide or chloroform, employing usually 1 mm. cell and concentrations ranging from 0·01 M to 0·1 M and are shown as plots of percentage absorp-

tion against wave number. Each spectrum has been divided into three regions extending over the ranges 1,800 — 1,580 cm.$^{-1}$, 1,480 — 1,300 cm.$^{-1}$ and 1,400 — 650 cm.$^{-1}$, and for each of these regions, different experimental conditions have been employed depending on the absorption characteristic of the solvents and the band intensities. There are also included in the book a few representative spectra in the region 2,600 — 3,800 cm.$^{-1}$ Each spectrum has been allotted a full page and consequently, there is a high degree of fidelity of reproduction of the spectra. There is no doubt that the book will serve as an invaluable aid to research workers in the field of steroids. S. SWAMINATHAN.

**Neutron Optics.** (*Interscience Tracts on Physics and Astronomy No.* 1.) By D. J. Hughes. (Interscience Publishers, New York), 1954. Pp. vii+136. Price $ 2.50.

These Interscience Tracts prepared under the editorship of Professor R. E. Marshak are intended "to provide non-specialists with authoritative and relatively brief and inexpensive accounts of recent advances in the many specialized branches of physics and astronomy". The monograph under review amply fulfils this aim. It deals with the problem of the scattering of neutrons and its applications to nuclear physics, crystal structure and magnetism. The propagation of neutrons through matter is quite similar to that of electromagnetic waves and one can in fact talk of a complex index of refraction for the neutron waves. They can be reflected, refracted and diffracted. Monochromatic (mono-energetic) neutrons can be produced by crystal reflection as with X-rays, and these can be used in the study of crystal structure. Since the scattering of neutrons is due to the nuclei of atoms and depends primarily on their nuclear structure, it is possible that elements, such as hydrogen, which are poor scatterers for X-rays are strong scatterers for neutrons. Neutrons have therefore been used for finding the position of hydrogen atoms in crystal structures. Again, since neutrons have spin, they can be magnetically scattered, a phenomenon having no counterpart in X-rays. This has enabled a detailed study to be made of the magnetic structure of ferromagnets and antiferromagnets.

There is a fund of information within the hundred and odd pages of this booklet, which should find a place in every physics library. Further numbers in the series will be eagerly awaited.

G. N. RAMACHANDRAN.

**Crystal Growth and Dislocations.** By Ajit Ram Verma. (Published by Butterworth Scientific Publications, Dist.: Lange, Maxwell & Springer, Ltd., London), 1953. Pp. xii + 182. Price 30 *sh.*

This book deals mainly with the experimental techniques developed during very recent years for the study of crystal growth and the results obtained therefrom. These are of two types, those using phase-contrast microscopy or the method of multiple-beam interferometry, developed in Tolansky's laboratory, and those making use of electron microscopy or electron diffraction. The author himself has obtained interesting new results with the former techniques and naturally therefore these are described in detail and occupy the major portion of the book. As the author states, "For electron microscopic techniques which I could not describe authoritatively, reference may be made elsewhere".

The book is based on the Ph.D. thesis of the author, but it is not merely a reproduction of the thesis. It is well written in a clear brief style omitting all unnecessary detail. Perhaps the only criticism that may be made is that in the portions describing the modern theories of crystal growth (Ch. 2), the author could have devoted a little more space and made the discussion complete in itself, instead of only mentioning the final results of the theory. However, the experimental sections are extremely well written, and the large number of beautiful photographs add much to the value of the book. In the small space of less than 200 pages, Dr. Verma has given a remarkably clear picture of the present state of the subject.

The book is well got up and the reproduction of the large number of figures (mostly photographs) is excellent; however, the price of 30 *sh.* appears to be excessive for a monograph of this size.

G. N. RAMACHANDRAN.

**Tables of Lagrangian Coefficients for Sexagesimal Interpolation.** (NBS *Applied Mathematics Series* 35.) (Order from the Government Printing Office, Washington 25, D.C.). Pp. 157. Price $ 2.00.

The Lagrangian interpolation formula is a tool of fundamental importance in problems of interpolation. Although many and extensive tables of Lagrangian interpolation coefficients have been provided for decimal subdivisions of the argument, few corresponding tables are available for arguments in sexagesimal measure, such as angles given in units of degrees, minutes and seconds. Even though interpolation is possible, it is a cumbersome operation to find the required coefficients in existing tables.

The present tables are designed to eliminate the need for such repeated interpolation. They should therefore prove to be a very useful tool for workers in fields such as astronomy, geodesy, ballistics, engineering and geography, where data are frequently in units of degrees (or hours), minutes and seconds.

**Select Methods of Metallurgical Analysis.** (Second Edition, Revised). By W. A. Naish, J. E. Clennell and V. S. Kingswood. (Chapman & Hall), 1953. Pp. xii + 660. Price 75 *sh.* net.

In preparing the second revised edition of the book under review the editor, Mr. Naish had rightly set up an editorial panel. The way in which the vast field of metallurgical analysis right from the sampling of the materials, qualitative detection of the elements and analysis of the ferrous and non-ferrous alloys and some of the important commercial metals have been dealt with cannot but be appreciated by them for whom the book is meant.

The book has been divided into six parts: the first part deals with the sampling of ores, alloys and other metallurgical products, standard methods of solution and separation and qualitative analysis. The importance of correct sampling has been rightly emphasised and different methods of sampling different substances have been dealt with.

Part II of the book deals with selected methods for the analysis of 49 elements. For each of the elements its metallurgical occurrence, source of the element for standards and methods available for determination by gravimetric, volumetric and colorimetric methods along with the theory have been given. This part will be of use to all chemists and help them in choosing the right method of analysis for any of these elements. However, it seems to the reviewer that it would have been better had ionic equations been used instead of the classical ones.

Standard methods for analysing seven commercial metals, non-ferrous alloys and irons, steels and ferro-alloys have been given in detail in the third part of the book. Different methods have been given for the determination of a particular element depending upon the fact whether the element concerned is pre-

sent in the metal or alloy as a major or minor constituent or as an impurity. Apart from gravimetric and volumetric methods, absorptiometric and polarographic methods have also been incorporated wherever these are more accurate or convenient. It is observed that in the case of some of the metals and alloys the limits of the constituents and impurities has been mentioned. It would have been better if the same procedure had been followed for all of them.

In the next two parts of the book the analysis of ores, slags, refractory materials and coal and coke are given. The treatment of the analysis of ores seems to be too brief. No method for determination of sulphur in zinc ores has been given. In the case of determination of sulphur in lead ores (galena) it is written, "Estimate exactly as described in copper ores" (p. 511). But sulphur in lead ores cannot be done exactly by the method given for copper ore (p. 498). This needs correction.

In the sixth and the last part, modern physico-chemical methods have been given. When within only 56 pages one has to deal with all the methods including absorptiometry, spectro-photometry, polarography and spectroscopic analysis, the treatment cannot but be too elementary both in theory and technique, and perhaps loses much of its practical utility. Would it not have been better if, instead, only electrometric titrations, calorimetric and absorptiometric methods have been dealt with in greater detail ?

On the whole the book is very well-written and will be of great help to those engaged in metallurgical analysis. T. BANERJEE.
H. P. BHATTACHARJEE.

**The Properties of Tin.** (Published by the Tin Research Institute, Perivale, Greenford, Middlesex, England), 1954. Pp. 55.

The new edition aims to present all the published atomic and nuclear, physical, physico-chemical and metallurgical data concerning pure tin, but does not give data for tin alloys, which are covered in a separate publication of the Institute. The main divisions of the data relate to atomic and nuclear properties, line spectra, X-ray data, crystallography, optical properties, electrical and magnetic properties, thermal properties and mechanical properties.

The book is intended for libraries and research laboratories to whom it will be distributed, free of charge ; for private readers there is a charge of 2 shillings and 6 pence in part defrayment only of printing costs.

**Organised Industries of India—Cement.** By S. L. Sharma. (Universal Publishers, Hozratganj, Lucknow), 1954. Pp. 70. Price Re. 1.

This is a series of booklets designed to meet the needs of businessmen, industrialists, students of economics and commerce and others to keep themselves informed of the economic activities of the country, both in the public and private sectors.

In this pamphlet the author considers the facts of Indian cement industry, its historical development, monopolistic tendencies, government regulation and control and the planning and possibilities of future development. On the basis of available statistics, the author makes several suggestions for the rationalisation of the industry including an interesting one, that in order to meet zonal requirements and for the utilization of locally available raw materials, low cost small-sized units of capacity 10,000-30,000 tons, working with vertical shaft kilns can be pressed into service with advantage. This low-priced booklet provides interesting and stimulating reading.

**Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds.** By F. D. Rossini, K. S. Pitzer, R. L. Arnett, R. M. Braun and G. C. Pimentel. (Am. Petroleum Institute, Carnegie Press, California Institute of Technology), 1953. Pp. 1050. Price $ 7.00.

This useful and critical compilation of data is an accomplishment of the A.P.I. Research Project 44, and has for its object the provision of basic data and background information of real value in the planning and development of new or improved methods for the discovery, production or refining of petroleum. Several reputed physicists and chemists have co-operated in the programme over a number of years to appraise critically the validity of the selected data on physical and thermodynamic properties, and infra red, Raman and mass spectra data. This volume thus serves as to-day's standard of physical and thermodynamic data on hydrocarbons.

The physical properties include the following : boiling point and pressure coefficient of boiling point at atmospheric pressure, refractive index, specific gravity, specific dispersion, viscosity, vapour pressures, critical pressures, compressibility factor, surface tension, heat of vapourisation, heat of combustion, heat of formation, entropy, the cryoscopic constants, etc.

The compounds covered in the work, include hydrocarbons of all types and molecular

weights and all non-hydrocarbons of import-ance to the petroleum industry. The latter include organic sulphur compounds, organic oxygen compounds, simple nitrogen compounds and certain halogens and halogenated com-pounds. To facilitate use by engineers as well as chemists and physicists, the selected values have been converted to engineering units as appropriate.

In order to keep these compilations uptodate, new tables and revisions are printed on loose leaf sheets and distributed once or more each year. This distribution is gratis to most of the libraries and research organisations of the world.

**Fruit From Trained Trees.** By Stanley B. Whitehead. (Published by J. M. Dent & Sons, London), 1954. Pp. 151. Price 10 *sh.* 6 *d.*

Modern fruit-growing has undergone revolu-tionary changes. The advent of selected root stocks of known performance and effect has helped to modify the habit of growth of fruit trees and force them into bearing early and in plenty. This attractively produced little volume on "fruit trees" is unique inasmuch as it deals exclusively with those forms of fruit trees which can be trained to grow within a limited space either in the open or on the walls with a habit of growth that can be easily modelled to encourage consistent and good bearing. It describes in simple and lucid lan-guage every aspect of intensive production of fruits from trained trees such as apples, pears, nectarines and peaches, apricots, plums and gages, cherries, figs and currants, gooseberries, brambles and grapes. Although the book deals mainly with the fruits of temperate regions, it provides quite many useful and practical hints to fruit-growers and amateur gardeners in the tropics as well.

The book is divided into 13 chapters. The first chapter describes what a 'trained fruit tree' is, its care and culture, while the second chapter details the planning of modern fruit garden, the choice of its site and soil. In the remaining eleven chapters, each fruit tree is dealt separately, with exhaustive notes on their raising, shaping, culture and harvest. At the end of each chapter, special requirements of individual fruit trees are mentioned with details on pests and diseases and their control mea-sures. Hints regarding the intricacies of prun-ing of oblique Cordon trees, vertical Cordons and Espaliers, dwarf pyramids and fan-shaped

trees, are a special feature. The spraying calendar and the list of recommended varie-ties for each type of fruit, greatly enhance the value of the book. The inclusion of Appendix on propagational methods of tree fruits and the insecticides and fungicides are definitely of immense help.

The get-up of the book is excellent and it is richly illustrated and includes carefully chosen photographs and informative line drawings. Dr. Stanley B. Whitehead and his publishers are to be congratulated for producing a very fine book for all those "interested in the plea-surable and profitable task of growing delect-able fruits in the most modern way".

N. L. DUTT.

**Fluorescence Analysis in Ultraviolet Light.** By J. A. Radley and J. Grant. (Fourth Edition). (Chapman & Hall), 1954. Pp. xvi + 560. Price 52 *sh.* 6 *d.*

This volume is a revised and enlarged fourth edition of the book first published in 1933. As the third edition was published as early as 1939, the publication of the fourth edition now will be welcomed by all who are interested in fluorescence analysis in ultraviolet light, since during this period, various instruments used in this type of work have been improved and quite an extensive literature has also accumu-lated on different aspects of the subject.

The book is divided into two parts : in Part One, there are five chapters dealing with the theory and technique of fluorescence analysis. Description of several types of lamps and fil-ters have also been given. In the second part, 20 chapters are devoted to the applications of this technique in different fields. Thus, one chapter each relates to agriculture, bacteriology, botany, constructional materials, drugs, foods and food products, fuels and lubricants, in-organic chemistry, leather and tanning, legal and criminological work, medical and biologi-cal science, minerals and gems, museum work, organic chemistry, paints and varnishes, paper and cellulose, rubber, textiles and dyestuffs. Forty-five excellent photographs are also in-cluded at the end to illustrate the various applications of fluorescence analysis.

A special feature of the volume under re-view is the exhaustive list of references col-lected and given at the end of every chapter. One may perhaps criticise the paragraph head-ing on p. 233 of vitamin $B_5$ for nicotinic acid as out of date, which may preferably be omit-ted in future editions. The authors' have drawn

largely on their rich and varied experience of investigations in this particular field, and pro-duced an excellent monograph, which should serve as a standard reference book on all aspects of fluorescence analysis in ultraviolet light.

P. S. SARMA.

The Wealth of India—Industrial Products, Part III: D-E. (Published by the C.S.I.R., New Delhi), 1953. Pp. 250 with 13 plates and 94 text illustrations. Price Rs. 20.

Part III of *Industrial Products* comprises articles beginning with the letters D and E. It includes monographic information on fifty-four industries, some of which have been grouped together under major subject heads. Thus thirteen industries, including radio receivers and components, telegraph and telephone equipment, transformers and wires and cables, are included under the subject Electrical Industries'; fifteen items, including lemongrass oil and sandalwood oil, are included under 'Essential Oils'.

In compiling the articles, an attempt has been made to trace the development of the industries dealt with and to describe their present position ; the principal raw materials, their sources and availability are indicated ; a description of the manufacturing process is given ; and available statistical data are presented. This volume includes also an index to the first three of the series.

This encyclopædic work, planned and produced with much care and labour, is bound to be as well received as its predecessors.

Books Received

*The Vitamins,* Vol. I. Edited by W. H. Sebrell Jr. and R. S. Harris. (Academic Press, Inc., Pub.), 1954. Pp. xiii+676. Price $ 16.50.

*Advances in Carbohydrate Chemistry,* Vol. VIII, Edited by C. S. Hudson and M. L. Wolfrom, (Academic Press Inc., Pub.), 1953, Pp. xvii+408, Price $ 10.00.

*International Scientific Radio Union.* Special Report No. 3. *Discrete Sources of Extra-Terestrial Radio Noise.* (General Secretariat of U.R.S.I. 42 rue des Minimes, Brussels), 1954. Pp. 56. Price 11 *sh.*

*The Structures and Reactions of the Aromatic Compounds.* By G. M. Badger. (Cambridge University Press), 1954. Pp. xii + 456. Price 63 *sh.*

*The Reactivity of Free Radicals—Discussion of the Faraday Society,* No. 14. (The Aberdeen University Press), 1953. Pp. 256. Price 35 *sh.*

*The Chemistry of Heterocyclic Compounds— Compounds with Condensed Triophene Rings.* Vol. 7. By Hartough and S. L. Meisel. (Interscience Publishers, Inc.), 1954. Pp. xv + 515. Price $ 16.50.

*The Biochemistry of Brewing.* By I. A. Preece. (Macmillan & Co.), 1954. Pp. vii + 393. Price 25 *sh.*

*Minerals for the Chemical and Allied Industries.* By Sydney J. Johnstone. (Chapman & Hall), 1954. Pp. 692. Price 75 *sh.*

*The Moon Puzzle.* By N. O. Bergquist. (Grafisk Forlag, Copenhagen, Denmark), 1954. Pp. xiii + 378.

*Chemical Engineering.* Vol. I. By J. M. Coulson and J. F. Richardson. (Pergoman Press, Ltd., London), 1954. Pp. viii + 370. Price 38 *sh.* 6 *d.*

*Electromagnetic Theory.* By U. C. A. Ferraro. (The Athlone Press, London. Orient Longmans, Ltd., Madras 2), 1954. Pp. viii+555. Price 42 *sh.*

*Handbook of Cosmetic Materials.* By Leon A. Greenberg and David Lester. (Interscience Publishers, Inc. Asia Publishing House, Bombay-1). 1954. Pp. xii+455. Price $ 12.50.

*Name Reactions in Organic Chemistry.* By A. R. Surrey. (Academic Press), 1954. Pp. viii+192. Price $ 4.00.

*Advances in Enzymology,* Vol. XV. Edited by F. F. Nord. (Interscience Publishers, Inc.), 1954. Pp. x + 547. Price $ 11.00.

*Intermediate Zoology.* By D. R. Puri. (Published by S. Chand & Co., Fountain, Delhi), 1953. Pp. 441. Price Rs. 9.

*Rice Breeding and Genetics.* By K. Ramiah with the assistance of M. B. V. N. Rao. (Indian Council of Agricultural Research), 1953. Pp. vii + 360 + 5. Price Rs. 17-8-0 or 27*sh.*

# SCIENCE NOTES AND NEWS

## Presowing Induction of Sugarcane Setts by Coloured Lights

Sri. M. S. Subba Rao and C. P. Sinha, Central Sugarcane Research Station, Pusa, Bihar, writes as follows:

In an attempt to improve germination percentage, studies were initiated on the effects of various components of white light on the germinating capacity of sugarcane setts. Blue, green, red and white lights were directed on one-budded setts of uniform vigour for 24 hours in wooden boxes. These lights were obtained by wrapping up coloured paper over a 500 watt bulb at a distance of 4'. Twelve setts were treated separately for each plot and they were sown in microplots of 6' × 6' size with four replications.

Amongst different coloured lights green, red, white and blue are helpful to germination in the decreasing order. It was significant to note that green light was most useful for germination, while it is well known that red light is most useful for photosynthesis.

The authors are highly grateful to Sri. K. L. Khanna for his interest and kind encouragement.

## Cobalt as a Carcinogen

The possibility of cobalt functioning as a carcinogen has been reported by J. C. Heath in *Nature* (1954, 173, 822).

Some pure 400-mesh cobalt powder was mixed with fowl serum, and a quantity of 0·028 g. cobalt in 0·4 ml. serum was injected into the thigh muscles of rats 2-3 months old of the hooded strain. Ten male and ten female rats were so treated and a further ten male and ten female animals of the same strain and age were similarly injected with fowl serum only. There was little or no reaction immediately after the injection, and nothing was observed up to some five months, when two male rats began to develop tumours at the site of injection. One month later, these tumours measured approximately 3 cm. × 3 cm. and at autopsy were found to be malignant neoplasms.

## Thermo-Junction Cooling Unit

In the past little use has been made of the Peltier cooling effect, which occurs when an electric current flows through the junction between two different metals, in the appropriate direction. At the Royal Society's Conversazione held recently, a demonstration was given of a semi-conductor thermo-junction which, it is claimed, will give a cooling effect of nearly 50° F. New semi-conductor materials are being developed which are expected to make still larger cooling effects possible. Success appears to depend upon the production of materials with high electrical conductivity and low thermal conductivity, as the Peltier cooling effect is usually much less than the heating effect in the junction because of its own resistance.

At the Conversazione, a unit employing bismuth and a bismuth-tellurium compound was demonstrated which produced miniature ice-cubes, but at present this efficiency is certainly much less than that of conventional motor-driven refrigerators.

## German Developments in Plastics and Synthetic Rubber

Abstracts of recent German patent applications on new processes and products in the field of plastics and elastomers are offered in a new bulletin issued by *Research Information Service*, 53, Nassau Street, New York 38, N.Y. Translations of all these patent applications can be obtained in the form of RIS Reports at the prices indicated in Bulletin No. 87—*Plastics and Synthetic Rubber*.

The variety of subjects covered by these reports is suggested by the subdivisions of the Bulletin: elastomers; vinyl and ethylene polymers; acrylics, phenolics, alkyds and polyesters; plasticizers and miscellaneous products and processes.

## Construction of Laboratory Apparatus for Schools

UNESCO has brought out a portfolio of eighty drawings of scientific equipment, intended primarily for manufacturers but suitable also for school workshops. They include complete lists of materials required for each item, exact specifications for each part, and instructions for assembly, together with brief indications of the purpose of each item in school use. The combination of the drawing with the specifications and instructions will enable trained workmen to produce school apparatus equal to the best.

There are two series of drawings in the portfolio—one includes the minimum equipment needed for the successful teaching of what is called "general science" in elementary schools and in lower secondary schools ; the second includes equipment for more advanced instruction in the more specialized courses in physics, chemistry and biology in secondary schools. The various items are arranged by scientific subjects. The portfolio is bilingual (English and French) and is priced at $ 8.00.

## Napier Shaw Memorial Prize

The Royal Meteorological Society announces the first competition for the Napier Shaw Prize of £ 100. On this occasion it will be awarded to the author of the best original essay in English on 'The Energetics of the General Circulation'. The competition is open to all nationalities, and essays must be presented before 4th March 1956. Details of the competition may be obtained from the Assistant Secretary, Royal Meteorological Society, 49, Cromwell Road, S.W. 7.

## *International Biological Abstracts*

Dr. Jacob Chandy, Department of Neurology and Neuro-surgery, Christian Medical College Hospital, Vellore, S. India, has kindly consented to edit and forward abstracts of articles from *Current Science* for inclusion in the *International Biological Abstracts*. It would be helpful if abstracts of relevant articles are sent to Dr. Chandy soon after their publication in *Current Science.*

## Indian Botanical Society

At a meeting of the members of the Indian Botanical Society residing in and around Dehra Dun held recently, it was decided to start a local branch of the Society with the object of promoting the cause of botany in all its aspects. Dr. K. A. Chowdhury and Mr. M. B. Raizada were elected President and Secretary of the local Branch.

## Dr. S. L. Hora

Dr. Sunder Lal Hora, Director, Zoological Survey of India, has been appointed as Fish and Wild Life Adviser to the Damodar Valley Corporation with effect from 15th July 1954, for a period of two years. He is also Honorary Secretary-General, Indian Board for Wild Life and Fish Consultant to the Food and Agricultural Organisation of United Nations.

## Kalinga Prize Award, 1954

Mr. Waldemar Kæmpffert, science editor of the *New York Times,* has been elected to receive the 1954 Kalinga Prize, awarded annually by the UNESCO for distinguished science writing. The award will be made by Dr. Luther Evans, Director-General of UNESCO, at a ceremony to be held in Paris in September.

Waldemar Kæmpffert has been science editor of the *New York Times* since 1927, and for a quarter of a century has written many editorials and reviews of scientific books for the *Times* and a large number of special articles in American weekly and monthly magazines. His books include : *The New Art of Flying, the ABC of Radio, Invention and Society, Science Today and Tomorrow* and *Explorations in Science.*

## Fourth World Forestry Congress

The Fourth World Forestry Congress (with which is incorporated the World Tropical Silviculture Congress) is due to be held at Dehra Dun from 11th to 22nd December 1954. This Congress, which is essentially held for technical discussion, will devote special attention to Tropical Forestry. India is to be the host country, and a special number of the *Indian Forester* will be issued in honour of the occasion. Contributions are invited from foresters all over India so as to make the number a success. The articles need not be elaborate : what is required is a simple statement of the actual research work done or any new observations made by foresters in the field and the conclusions, tentative or otherwise, drawn or indications obtained from them. Such contributions may be sent to the Honorary Editor, *Indian Forester,* New Forest P.O., Dehra Dun.

## Symposium on Indian Essential Oils and Aromatic Chemicals

A symposium on research and development in Indian essential oils and aromatic chemicals will be held on September 27-30, 1954, at the Forest Research Institute and Colleges, Dehra Dun, under the joint auspices of the Forest Research Institute and Colleges and Essential Oils Committee of the CSIR. Persons desirous of participating in and contributing papers to the symposium may kindly address Dr. Sadgopal, Secretary of the Organizing Committee, for further particulars.

## UTILISATION OF SCIENTIFIC RESEARCH

EVEN a brief study of the history of science is enough to convince anyone that there is usually a large time lag between the announcement of a great discovery and its utilisation by industry and the common man. At least a generation had to pass away before the applications of Faraday's classical researches on electromagnetism or Curies' researches on radium reached the people. Even in the recent instance of penicillin, nearly eight years elapsed between Fleming's initial discovery and the subsequent work of Florey and Chain.

A reasonable time lag in such instances is perhaps understandable, but it is clear that in most cases it could be made considerably shorter. In fact, it was emphasised during the British Commonwealth Scientific Official Conference in 1946 that research itself may be in vain unless definite steps were taken by scientists to see that the results of scientific work of potential value to humanity do not lie unused in technical papers and government archives. Research organisations or associated bodies, it was suggested, must accept the res-

ponsibility for the utilisation of their results. As Sir Henry Tizard observed in his presidential address to the British Association in 1948, "it is not the general expansion of research that is of first importance for the restoration of industrial health, and certainly not the expansion of government research remote from the everyday problems of industry; what is of first importance is to apply what is already known".

In this connection, the Report (now published in book form*) presented to the British Commonwealth Scientific Conference held in

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Australia in 1952, contains many valuable suggestions and is worth our careful study.

The obstacles to the practical application of the results of research, the Report observes, may range from the 'pure' scientist's conviction that research and publication is an end in itself, through the managerial board's fear of plant obsolescence and heavy capital expenditure, to the possible non-co-operative attitude of foremen and trade union officials who see a threat to working conditions. At the other end of the scale, there have been cases, particularly in the development of new antibiotics and hormone drugs, where premature publicity has stimulated public demand before a manufacturing process has been perfected, and has even prejudiced complete scientific evaluation of the discovery.

The publication of the results of scientific research, no doubt, constitutes an important stage in scientific research, but in the present context of growing public consciousness, it would be a great gain if the scientific worker realises that there is still much ground to be covered between the publication and its application. As for the economic and psychological factors associated with resistance to change on the part of industry and the laity, these need to be carefully analysed and allowed for. In fact, the Report emphasises that official scientific organisations are unlikely to be successful in this direction unless they enjoy the confidence of those responsible for organised industry, including chambers of commerce and the industry on the one hand, and trade unions on the other. The possibilities offered by educational methods of bringing home to the industrialists and others of employing more scientists and technologists at all levels should also be fully explored.

It is of interest to consider here to what extent the conventional methods in use at present—such as publication, abstracting services, etc., may be expanded into something more positive and depending to a large degree on personal contacts.

In regard to this issue, the recommendations made by the Special Committee on Information Services are worth quoting: (*a*) *Publications*: These should be issued, not only as papers for other scientists, but also in forms suitable for various levels within industry, *e.g.*, managing directors, plant engineers or foremen, as appropriate. (b) *Films, exhibitions*: These may profitably include travelling exhibitions and demonstrations and Open Days at research institutions. (c) *Information Services*: These

should aim wherever possible at giving technical as well as scientific information. (*d*) *Trainee Schemes*: A number of research institutions have found it useful to encourage their staff to take part in the teaching work of technical colleges specializing in the techniques of their industries. Some also arrange to great advantage conferences of managers, industrial engineers and foremen as a means of spreading information on new techniques of processes. (*e*) *Use of Consultants*: While in most countries paid consultants are employed by individual firms to advise on improvements, some research institutions have found it useful to provide, particularly for the smaller firms, industrial liaison staffs, whose duty it is to visit these firms and advise on improvements based on the best practice of the industry.

The problems connected with the translation of a piece of research into a form serviceable to humanity are perhaps greater in our country than elsewhere, but we feel that a great beginning has been made in this direction by the establishment of a network of information services at each of the National Laboratories. The institution of the National Research Development Corporation (recently announced by the Government of India), with the primary object of undertaking in the public interest development to the production stage of scientific discoveries made in government research laboratories, universities and elsewhere, is indeed a welcome move in this direction. The Indian Scientific Documentation Centre established in 1952 with the collaboration of the UNESCO also deserves mention in this connection.

In a brief notice like the present one, it is hardly possible to do any justice to the host of issues raised by the application of the results of research. However, considering the time and energy which go into the working out of a research programme, it would indeed be a pity if the results thereof should remain unused. Men of science have no doubt a responsibility in this matter, but we should be sadly overstating the case if their responsibility can in any way be regarded as greater than that of industry, management and labour. The whole-hearted co-operation by all sections of the community is therefore essential in making the best possible use of scientific research; but to give effect to it requires, in the words of the Report, conviction of its necessity, continuous and close attention to its operation, imaginative but realistic choice of the methods to be used, and persistence in their application.

# THE ANTI-PROTON

AT the American Physical Society Convention held in Seattle recently, Dr. Marcel Schien of the Chicago University reported that he observed a peculiar ray track through the pack of photographic plates sent in a balloon up to 10,000 ft. to be exposed to powerful primary cosmic radiation. The track was a bundle of slim V's made by pairs of negative and positive electrons, and there was no trace of larger charged particles (*e.g.*, protons) usually present. His tentative conclusion is that some particles had hit the film pack with energy of the order of $10^{15}$ electron-volts.

This energy is more than 1,500,000 times the energy of the particles shot out by the University of California's powerful bevatron, and 50 million times the energy of splitting uranium atom in an atomic bomb. What had caused the ray track is most probably an illusive particle called an anti-proton (negative proton), which theoretical physicists have long guessed about, but never observed. Dr. Schien believes that it hit an ordinary proton in the aluminium

wrapping of the film pack and that the two particles annihilated each other, turning all of their mass into energy. The peculiar track was made by the enormously powerful gamma rays thus produced, which created electron-positron pairs as they streaked away from the site of the collision.

Dr. Schien has no theory about the possible origin of the anti-protons. But according to him it is quite possible that remote stars may be made of "reversed matter", whose atoms have negative anti-protons in their nuclei and positrons (positive electrons) revolving around them. The reversed matter would send out the same kind of light as ordinary matter. It would behave itself normally as long as it stayed there. But if particles from an anti-proton star should wander into a region, like the earth's atmosphere, where the other kind of matter abounds, an encounter of the above type is quite probable, resulting in the production of gamma rays.

# ATOMIC BATTERIES

A new method which, makes it possible to convert atomic energy directly and simply into small but usable quantities of electrical energy sufficient to operate a transistor has been announced by the Radio Corporation of America.

The new type of battery consists of a radioactive source to which is coupled a wafer of semi-conducting crystal (germanium or silicon). An impurity material has been alloyed into the crystal to form a junction. The junction is similar electrically to those used in a junction transistor, but is considerably larger, with an area of 1/20th of a square inch.

In the battery, 1/300th of a c.c. of radioactive strontium is spread in a thin layer against the junction wafer. The layer of strontium bombards the semi-conducting crystal wafer with several billion electrons per second. As the electrons penetrate the wafer, they release many more electrons, an average of 200,000 for each bombarding electron. These released electrons flow across the wafer's junction producing a voltage which can be applied to an electronic circuit and cause a current to flow.

When connected to the transistor oscillator circuit, the battery's 1/5 volt potential provides a current of 5 microamperes, an output of approximately one millionth of watt. The best efficiency of energy conversion so far obtained exceeds 1 per cent., *i.e.*, the ratio of useful electrical power developed by the battery is at least 1/100th the energy of the beta particles as they leave the radioactive source. The greater part of the original energy is lost as heat in the crystal wafer. As present techniques are refined, an efficiency of 10 per cent. appears to be a reasonable goal for such devices. But greater power can be achieved by increasing the present quantity (50 millicurie) of strontium-90 or by placing a number of such units in a single container.

An aspect of atomic batteries that has yet to be determined accurately is the extent of the effect of the beta radiation on the crystal wafer: for it is well known that the crystal structure of any substances is gradually damaged by bombarding electrons. Further research would seem called for to minimize these effects.

# AN UNUSUAL APPEARANCE OF DESERT LOCUST SWARMS ON THE MALABAR COAST IN OCTOBER 1952

Y. RAMCHANDRA RAO

*Retired Entomologist, Bangalore*

## 1. THE SPECIES OF LOCUST CONCERNED

IN October 1952 locust swarms were reported along the West Coast of Madras on a fairly wide front—extending over a stretch of nearly 300 miles—from near Mangalore (13° N. Lat.) in the north to very near Quilon (9° N. Lat.) in the south. Although there was no definite mention of any date on which the swarms were first noticed, flights had doubtless occurred between the 12th and the 14th October and by the 15th most of the locusts had been killed off by birds. Locust wings are said to have been found strewn in abundance on the ground wherever flights had occurred. Apparently, the greater part of the migrating swarms had been drowned in the sea and those that reached land were in too exhausted a condition either to damage crops or even to escape the attacks of birds.

As the specimens received at Coimbatore had been provisionally identified as the Bombay Locust (*Patanga succincta* Linn.), it was presumed that flights of this locust had had their origin in Bombay State, but enquiries made of the Agricultural Entomologist, Poona, in the matter elicited the information that there had been no signs either of locust breeding or of any kind of swarms in the Bombay area. As no swarms were said to have occurred even in Goa territory, the origin of the Malabar flights became involved in a sort of profound mystery, which became resolved only in July 1953, when the writer visited Coimbatore and found that the samples received were, in reality, only the pink-coloured, immature, *gregaria* phase individuals of the Desert Locust (*Schistocerca gregaria* Forsk.) (Rao[1]).

## 2. POSSIBLE ORIGIN OF THE MALABAR SWARMS

An examination of the locust bulletins issued by the Director, Locust Control in India, made it clear that no swarms had been reported at this time from any of the areas adjoining the Madras State. Locust-breeding had occurred in the desert areas of Rajasthan in August-September 1952, and locusts that had escaped destruction had been forming swarms that were flying out of Rajasthan by the end of September and the beginning of October into the Punjab areas in the north, into Uttar Pradesh and Central India to the east and into north Bombay, Kutch and Saurashtra to the south. The



FIG. 1
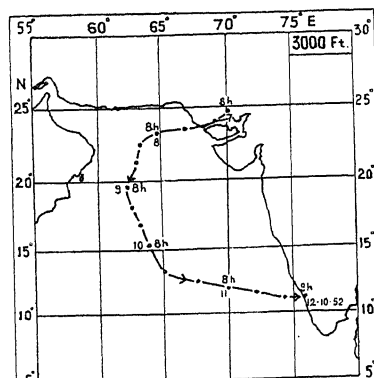
FIG. 2
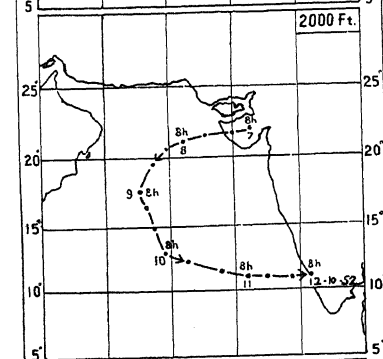
FIG. 3
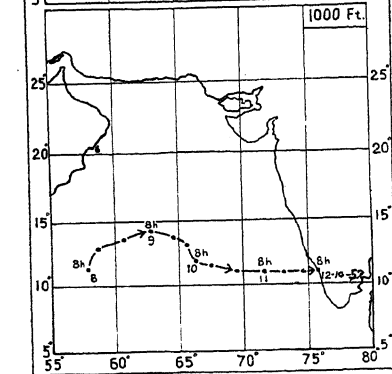
FIGS. 1 to 3.—Showing the Trajectories of the probable line of flight of hypothetical locust swarms reaching Kozhikode (Calicut) at 8 a.m. on 12th October 1952 at different heights above sea-level. The lines have been worked out by tracing them back in accordance with the direction and velocity of air-flow recorded at heights of 1,000 ft., 2,000 ft. & 3,000 ft. above sea-level respectively for every period of eight hours in the areas concerned. It may be noticed that, while the trajectory at 1,000 ft. was not helpful, those at 2,000 ft. and 3,000 ft. led to the Kutch and Kathiawar areas, indicating them as places of origin.

nearest areas from which the Malabar swarms could have been derived was evidently the Kutch Coast. A cursory examination of the synoptic charts of the India Daily Weather



FIG. 4

FIG. 5

FIG. 6

FIGS. 4 to 6.—Synoptic Charts showing the pressure distribution and the isobaric patterns that prevailed on the 7th, 8th and 9th October 1952 along the West Coast of India and on the Arabian Sea. On the 7th and the 8th, a low pressure trough prevailed off the Konkan-Kanara Coast of Western India, which induced strong North-easterly winds to the west of the trough.

Reports of the period concerned indicated that the development of an incipient depression along the Konkan-Kanara coast at the end of the first week of October 1952, had possibly helped in the transference of swarms from the Kutch area to the Malabar Coast over the

Arabian Sea to the west of the low pressure trough, thereby leaving the intermediate coastal area unaffected.

In this connection, attention may be drawn to the description (Waloff[2]) of a case of long-range migration of the Desert Locust that had occurred in October 1945 across the sea from Southern Morocco to Portugal and Spain under the influence of a depression in the Atlantic. Rainey and Waloff[3] have further clearly shown that it is possible to interpret various observations recorded in respect of flights of swarms in the Gulf of Aden area with the help of trajectories of movements of air-masses and thereby trace them to their origin. With the object, therefore, of making a similar detailed study of the meteorological conditions of the period concerned, the Meteorological Office at Poona was approached for help in the matter and a visit was paid to Poona during the second week of June 1954. All available data in respect of the Malabar visitation were discussed with the officers of the Meteorological Office and their kind help secured in the matter of their correlation with recorded weather data.

3. ANALYSIS OF DATA ON LOCUST MOVEMENTS IN RELATION TO WEATHER

(a) *Conditions in Rajasthan during the first week of October 1952.* As a rule, monsoon withdraws from Rajasthan by the first week of September, after which this region becomes an area of drought characterised by fairly high temperatures and low air humidity—conditions uncongenial to locusts, which they usually try to escape from. The temperature and humidity conditions observed in the West Rajasthan areas between the 3rd and the 12th October 1952 are given in Table I.

TABLE I

| Dates | Max. temp. Deg. F. | | | Rel. Humidity at 5-30 p.m. in % | | |
|---|---|---|---|---|---|---|
| Oct. 3 | 101 | to | 106 | 18 | to | 48 |
| ,, 4 | 100 | to | 106 | 13 | to | 70 |
| ,, 5 | 101 | to | 105 | 12 | to | 35 |
| ,, 6 | 103 | to | 109 | 12 | to | 38 |
| ,, 7 | 97 | to | 107 | 12 | to | 45 |
| ,, 8 | 89 | to | 101 | 28 | to | 38 |
| ,, 9 | 95 | to | 98 | 20 | to | 55 |
| ,, 10 | 99 | to | 102 | 17 | to | 52 |
| ,, 11 | 99 | to | 105 | 18 | to | 53 |
| ,, 12 | 98 | to | 102 | 8 | to | 72 |

From the above data, it would be seen that the uncongenial conditions that prevailed between the 3rd and the 7th October were conducive to the taking off of locusts from the

area, whereas somewhat milder conditions were met with from the 8th to the 12th in Rajasthan.

(b) *Swarms recorded during the first fortnight of October 1952 in the North Bombay, Kutch and Saurashtra areas:*

(Extracted from the *Locust Bulletin of Director,* Locust Control in India for fortnight ending 15th October 1952.—Vol. III, No. 19.)

*North Bombay Area: Palanpur Dt.:* 2nd to 11th October: Several swarms noted in Vav, Tharad, Palanpur, Deodar, Deesa, etc. Talukas; Mostly pink. Many NE to SW in direction.

*Mehsana* Dt.: Radhanpur Tq. 6-10 Oct. Pink Swarms: NE-SW.

*Ahmedabad Dt.:* Viramgam Tq. 1-7 Oct. Pink swarms.

*Kutch Area:* Bhuj Tq. 8th October. Pink swarms; NE-SW.

Khavda Tq.: 3-4 Oct. Pink swarms.

Adhoi Tq. 7-8 Oct. Pink swarms: NE-SW.

Abdassa Tq. 8th Oct. Pink swarm: NE-SW.

Nakhtrana Tq. First week of October. Pink swarms.

Mandvi Tq. 7-9 Oct. Pink swarms: NE to SW.

Lakhput, Mundra, Rapar, Khadir, Bachau and Anjar Taluqas: 7th Oct. Pink swarms NE to SW in direction.

*Saurashtra Area: Halar Dist.* Jamnagar Tq. 6th Oct. Pink swarms.

Khambalia Tq.: 6th, 8th Oct.: N to S.

It may be seen from the above that pink swarms had begun to enter the north Bombay and Kutch areas from the 3rd October and that the largest number of swarms were noted in the Kutch area on the 7th and the 8th, the direction of flights being north-east to south-west.

(c) *Possibility of Migration Flights from Kutch to Malabar.* From the data mentioned above, it is obvious that numerous locust swarms had taken off from the coastal areas of Kutch on the 7th and the 8th October 1952 and had probably been carried by the prevalent high winds over the sea in a south-western direction. As to the swarms reported on the Malabar Coast, there is no exact information as to the date on which they were first sighted, but there is little doubt that they had reached the coast between the 12th and the 14th October. As crews of steamers calling at Calicut at that period are said to have seen large sheets of drowned locusts in the sea, the swarms had evidently come flying across the Arabian Sea. The problem on hand is to find out whether by

tracing back their line of flight, their origin can be located.

Locusts are comparatively slow of flight and are incapable of covering large distances by their own efforts. It is evident, therefore, that in the present case they had been transported across the seas by the prevailing wind currents. Measurements of air-currents at different heights are being made 2 or 3 times a day, at selected points covering a large area of country and on the basis of these data, a set of lines of air-flow covering the whole area can be worked out, which may be held to be valid for about 8 hours. On the basis of these sets of lines and of the known velocity of wind, the course of flight that should have been taken by a swarm arriving at Calicut on the 12th October 1952 was successively traced back for every 8 hours. In this way, trajectories of air movements at heights of 1,000', 2,000' and 3,000' were separately plotted out and are shown in Figs. 3, 2 and 1 respectively. These clearly show that the swarms had been carried at levels higher than 1,000' and very probably at heights of 2,000-3,000' above sea-level. In the case of 2,000 and 3,000', the trajectories lead to Kutch and Kathiawar areas, wherefrom they should have started on the 7th October. The peculiar curve shown by the trajectories at levels of 2,000 and 3,000' was apparently due to the influence of a well-marked low pressure system off the Konkan-Kanara Coast (the iso-baric patterns of which are shown in Figs. 4 to 6 for three consecutive days), which had prevailed in the Arabian Sea on the 7th and the 8th October 1952 (but disappeared by the 9th) and had induced strong north-easterly winds up to a height of 3,000' and above, in the northern parts of the country, especially in the Kutch-Saurashtra areas. Owing to the development of conditions of desiccation marked by a rise of temperature and a fall of humidity in the desert areas of Rajasthan during the first week of October, swarms had begun to migrate from the area by the 3rd October into Kutch and North Gujarat areas. It is obvious that the swarms found in the Kutch-Saurashtra areas had been sucked up by the strong north-easterly upper air currents that had developed on the 7th and the 8th October under the influence of the trough of low pressure off the Konkan-Kanara Coast and had been carried far out over the sea.

The records of temperatures at different levels at Veraval in Table II on the 7th, 8th and the 9th October 1952 would indicate that

the temperature distribution over the neighbourhood was favourable for convection and the consequent lifting of locusts into the free air, particularly at the time of the maximum temperature on the 8th October. Upper air temperatures were also favourable for locust flight.

TABLE II

*Records of temperatures at Veraval*
7-9 *October* 1952

| Dates | Maximum | Temp. in °F. at 20–30 hrs. I.S.T. | | | | Remarks |
|---|---|---|---|---|---|---|
| | | Surface | 1,000 ft. | 2,000 ft. | 3,000 ft. | |
| Oct. 7 | 87 | 82 | 90 | 87 | 84 | Inversion (stable) up to 500 ft. |
| Oct. 8 | 95 | 84 | 82 | 81 | 80 | Stable up to 4,500 ft. Super adiabatic (unstable) from 4,500 ft. to 7,500 ft. |
| Oct. 9 | 98 | 84 | 90 | 90 | 84 | Inversion up to 1,200 ft. |

On the basis of the above data, it may be surmised that an emigration of swarms of the Desert Locust had occurred from the coasts of Kutch and Saurashtra in the course of the 7th and the 8th October 1952, and that they had been carried by upper air currents across the Arabian Sea in the course of 4 or 5 days and cast on the Malabar Coast between the 12th and the 14th October. It is not unlikely, however, that the great majority of the locusts had dropped into the sea out of sheer fatigue, which would account for the large sheets of drowned locusts found in the sea. In this connection,

it may be stated that in the year 1862, there is a record of locusts having been similarly driven into the sea along the coasts of Kutch. According to the *Gazetteer of the Bombay Presidency* (Vol. V, 1880), "Rainfall in 1862 was heavy—34″. The rains closed in October with a tremendous rainstorm, which not only caused damage to crops and life, but also drove locust swarms westwards out into the sea. Ship captains from Muskat and Zanzibar, some 100 miles from Mandvi found the sea covered with their dead bodies".

4. ACKNOWLEDGMENTS

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2. Waloff, Z., *Proc. Roy. Ent. Soc. Lond.* (A), 1946, **21** (10).
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## PERFECT CRYSTALS OF PURE IRON

THE General Electric Company have reported the development of perfect crystals of pure iron, a hundred times stronger than any known metallic crystal and inherently resistant to rust. These perfect crystals represent for the first time metals that are as strong as theory predicts they should be and, as such, "provide a new and exciting dimension in metallurgy". The crystals are metallic whiskers about one thousandth of an inch thick and an inch or so in length. They were produced in the company's Research Laboratory in Schenectady, New York, by Dr. Robert L. Fullman and Arno Gatti. It is hoped that in time, applied science and technology will find a practical use for this form of metal.

Ordinarily the strength of actual crystals is a hundred times or so less than the theoretical value. Metal parts used in machinery and other equipment similarly fall far short of the strength they might theoretically have. This is on account of the irregularities in the crystal on an atomic scale. As against this, the perfect crystals which have been made are stronger than any previously known metal or alloy, and actually attain a tensile strength of nearly a million pounds per square inch.

Moreover, these tiny perfect crystal wires of pure iron do not appear to rust. Finely divided iron, or fine wires of ordinary iron, rusts almost immediately upon exposure to air. The same atomic perfection that gives them strength probably also prevents oxidation.

## MATHEMATICS IN PRINTING*

THIS book, published by the Oxford University Press, is the first of its kind and deserves a hearty welcome by writers and printers of higher mathematics. Written in a simple style and finely printed in a type face that is mostly used for scientific, especially mathematical work, it should find a prominent place on the book-shelf of everyone connected with the printing of higher mathematics.

The book is divided into three chapters, written by different members of the Press, who had ample experience in their own fields. The first chapter relates very briefly, but clearly, how the mathematical "writings are transformed to the orderliness of a printed page". The author describes the important function of the hand compositor, stressing the difficulties he is confronted with. The workings of the monotype operating and casting machines have been described with the help of figures, pointing out their scope as well as their limitations.

No mention has however been made of the "mathematical" keyboard devised by the Lanston Monotype Corporation of America, which claims to eliminate 90 per cent. of the hand composing. Also the possibility of utilising the mono-photo machine for mathematical composition could have been hinted at.

On pp. 14 and 15 are reproduced a "copy", the same in mono-casting and its transformation into composed matter ready for printing. A comparison between the last two clearly shows that the maker-up has to remove the unwanted types and spaces cast by the machine and set the correct ones in their places; he has also to add a large number of types with proper justification. Considering the time lost in operating, casting and removing the unwanted types, and the wages paid to the operator and castor, as compared to those of the hand compositor, one is convinced that it will be economically wise to entrust the intricate formulæ to the hand compositor, leaving only text and single-line display formulæ to the operator.

The first chapter is largely introductory while the second chapter contains many valuable suggestions. This is the most important chapter of the three. It gives a sort of paternal advice to the novice on preparing his "copy" for neat printing. It also recommends some new and easy-to-print symbols and notations in place of the existing cumbersome ones. These suggestions and recommendations, if carefully considered and adopted, will, to a considerable degree, facilitate the task of the printer. Especially, the notation (appearing on p. 32) in the field of theory of numbers, is worth consideration by mathematicians.

The third chapter gives systematic and detailed instructions regarding the composing of mathematics. Though written for the compositors, it deserves careful study by the mathematical authors, who should get familiar with the style of the press. The authors of this book are aware of the various styles in vogue but differ from them for "good reasons". It would have been better had these reasons been stated somewhere very briefly, as it would have enabled other authorities to weigh them. At the end of the chapter are given a "supposed mathematical proof" with marks of corrections and the proof after the corrections have been carried out. Though the page is flooded with corrections, it lacks the following: (i) transfer of words from a closely set line to previous or the next line, and (ii) shifting to the right or left (apart from centering).

The book closes with three appendices and an index. Appendix A, giving a sample of legible handwriting deserves no comment. Appendix B gives a list of various Monotype series used in mathematical composition and also a list of mathematical signs. (The Hebrew "Aleph" is unfortunately missing.) This list will be of use to other printers to compare with their own list of mathematical signs and will serve as a useful guide. Appendix C gives standard abbreviations of general terms and periodicals. This is followed by an exhaustive Index.

The book, on the whole, is a welcome addition to books on printing, and should be of much use and guidance to printers and authors of mathematics alike. We are sure, by the time the next edition comes out, photo-composing would have made tremendous advances, and the process in our opinion will lend itself very nicely to mathematical printing.

The Commercial Printing Press,     S. RAMU.
Bombay.

## RAUWOLFIA SERPENTINA

*RAUWOLFIA SERPENTINA*, an ancient Indian plant with almost legendary use, is causing much stir among medical scientists the world over. The varying effects of the crude drug, in use for divergent ailments, is sought to be explained by recent extensive study by chemists, pharmacologists and clinicians. Like crude opium, the plant is capable of yielding several active principles, which should partially explain the divergent results. A recent issue* of the *Annals of the New York Academy of Sciences* contains comprehensive information on different aspects of the drug and describes the chemistry of the drug, its several alkaloid and non-alkaloidal active principles, pharmacology of a few separated active principles, the endocrine aspects of the drug, its clinical application, etc.

\* Vol. 59, Art. 1, pages 1-140. By F. F. Yonkman and 34 other specialists.

The main value of *Rauwolfia serpentina* to-day is for reducing blood pressure, when pathologically raised. The active principles so far studied seem to act centrally on the brain, as a sedative and also peripherally through autonomic and other mechanisms.

The elucidation of the exact mode of action of distinct active principles of *Rauwolfia* has been a subject of study in several pharmacological laboratories and clinical units. The issue referred to should therefore provide useful material not only as background but for further elucidation of the subject. The value of the compound should be established by findings of independent workers in the field and not only by manufacturing concerns interested in it from a commercial point of view.

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## ELECTRONIC TRANSLATION

RUSSIAN was translated into English by an electronic 'brain' recently for the first time, in a demonstration at International Business Machines Corporation, World Headquarters in New York. Brief statements about politics, law, mathematics, chemistry, metallurgy, communications and military affairs were submitted in Russian to the giant computer IBM 701, which turned the sentences into easily readable English within a few seconds.

The first step in preparing the electronic computer to repeat this human performance of a mechanical task was to write electronically, in plus and minus charges on a magnetic drum surface, 250 Russian words and their equivalents in English. Wherever a Russian word had more than one meaning, each meaning was given a rulesign. This set of electronic words then constituted the dictionary to which the 'brain' could refer.

The second step in preparing the IBM 701 to translate was to store detailed instructions each of which have a one to one correspondence with electrical charges on the faces of cathode ray tubes in the computer.

Students of language are now for the first time justified in undertaking serious study of language from a mechanical point of view. They have practical reason now for trying to find out how language actually functions.

## COLOR X-RAY PHOTOGRAPHS

THE procedure for taking colour X-ray photographs was recently explained to the IRE Convention by Professor R. Stuart Mackay of the University of California. By taking three ordinary X-ray pictures of a part of the body, each time using a different wavelength or energy, and then combining these pictures by projecting them through different colored filters, a single multi-colored image or photographic print results. More exactly, the differences in X-ray absorption characteristics are converted into visible colors.

Professor Mackay also described a related process for locating a given chemical element in a body. Here, one alternately observes the body by frequencies slightly higher and lower than the characteristic absorption. The difference in intensity is essentially a measure of the one element alone. A typical application would be the use of an iodine tracer inserted in the body to map out a particular organ. In ordinary X-ray pictures, blackening from the tracer might not be noticeably different from that of the surrounding body, but the color pictures would show it up.

# POSSIBLE DEEP SEA TURBIDITY CURRENT CHANNELS IN THE BAY OF BENGAL

ROBERT S. DIETZ

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IN 1948, the steamship *Albatross* of the Swedish Deep Sea Expedition obtained an echogram across the eastern Indian Ocean while *en route* to Ceylon along the track shown in Fig. 1. The Kelvin-Hughes echo sounder was



FIG. 1. Chart of the Bay of Bengal showing the bathymetry based on soundings shown of Hydrographic Office Chart No. 5445. The positions of the soundings are shown by dots. The track of the *Albatross* is shown along the bottom of the chart and the positions of the presumed deep sea channels are shown by circles along this track.

operated part of the time on the "normal scale" which gives only a small-scale presentation of the bottom topography, resolving only the gross topography, and part of the time on an "enlarged scale", which gives a "Blown up" portrayal of the bottom. Frequent use of the enlarged scale (in which the paper width of about 7″ represents 150 fathoms and the paper speed is about 15″ per hour) showed that the

sea floor in this region was extremely smooth except for the occasional trough-shaped depressions of the bottom. These are shown in Fig. 2.

The author was first shown these interesting features, along with other portions of the *Albatross* echograms, by Dr. Fritz Koczi and Dr. Hans Pettersson at the Brussels Meeting of the International Union of Geodesy and Geophysics. It was suggested that these depressions might be some type of tectonic feature such as a small graben. It was the view of Dr. Pettersson, leader of the Swedish Deep Sea Expedition, that the smooth bottom in this part of the Indian Ocean might be related to an extensive lava flow. In support of this interpretation, it was pointed out that the bottom seemed hard since the piston corer was broken at Station 209 and difficulty was encountered in coring at Station 210. The echogram shows little variation from a level plain over the area scanned between successive "pings". It seemed unlikely to the writer that a lava flow would be this smooth whereas a sedimentation plain might be profiles across deep sea channels formed by turbidity currents. A recent more detailed study of a microfilm copy of the *Albatross* echogram has given sufficient conviction of this point of view to publish this short note. The author wishes to express his thanks to Drs. Koczi and Pettersson for permission to utilize portions of the *Albatross* echograms to publish this interpretation.

For convenience, the depressions are termed here *Able*, *Baker*, *Charlie*, *Dog* and *Easy*, thus using the phonetic alphabet. *Able* is located in the central part of the eastern Indian Ocean about 400 nautical miles south-east of Ceylon whereas *Baker*, *Charlie*, *Dog* and *Easy* are located in a group about 120 nautical miles south-east of Ceylon. *Able* is especially remarkable. It is more than 4 miles across the top, it has a depth of 240′, and the sides are raised 90′ higher than the surrounding sea floor. In the centre a mound is present. *Baker*, *Charlie*, *Dog* and *Easy* are almost a mile across and have depth, respectively of 60, 180, 240 and 30′. The bilateral symmetry of all the depressions is striking. Of the ten sides shown, only the east side of *Charlie* is not raised.

FIG. 2. Echogram showing the presumed deep sea channels discovered by the *Albatross*. The vertical exaggeration is about twenty times. See the text for further explanation.

Leveed banks seem to be typical of the deep sea channels which are extensions of submarine canyons off California, suggesting that these Indian Ocean depressions may be channels. Such levees were first noted to be typical of the channel extension of La Jolla canyon across the gently sloping bottom of San Diego Trough.[1] Buffington[2] has described many leveed sub-sea channels off the West Coast. Dill, Dietz and Stewart[3] have reported that portions of the deep sea channel extension of the Monetary submarine canyon show levees. Through the courtesy of Heezen, the author was able to examine the original fathogram,[4] but saw no evidence of levees on this deep sea channel. However, Erickson, Ewing and Heezen[5] do not report levees from the deep sea channel which extends out from the Hudson submarine canyon over the deep Atlantic floor. Thus, levees do not invariably accompany deep sea channels but seem to be commonly associated with them. Recently, the U.S.S. EPCE (R) 857 of the Navy Electronics Laboratory recorded four deep sea channel-like crossings with an Edo echo sounder off northern California and Oregon. One channel was traced for about 200 miles and, on some crossings, was leveed.

The raised sides of these Indian Ocean depressions do not preclude the possibility of their being tectonic features, but the fact that the wider are concave rather than convex upward makes the possibility that these are collapsed doomes unlikely. In the author's opinion, the most logical explanation is that they are deep sea channels formed by turbidity currents flowing out from the Bay of Bengal. The low gradient of the raised sides and the symmetry in profile of the depressions seem to preclude their formation by mud flows or by turbidity currents of great volume and nicely adjusted to the gradient of the sea bottom appear to be required. Such currents must more than fill the channel so that eddies, too small to continue on as independent turbidity flows, are sluffed off. These must fix with the surrounding bottom water and slowly drop their load of suspended particles. As noted above, *Charlie* lacks a "levee". Is it not possible that this well-developed "levee" formed on the outside of a turn in a channel where any overflow would take place over the outside bank?

It may appear to some readers that turbidity currents have been too widely invoked as a sea floor process in the past few years. It is well known, however, that a very slight increase of salinity or a decrease of temperature of a water mass with respect to the surrounding water will cause it to underflow the surrounding water, if the mass of water with increased density is large. Bell[6] showed that an increase in the volume of stream-fed cold water entering Shaver Lake greatly reduced mixing. If there is sufficient internal turbulence, to prevent the setting out of particles, it is reasonable to expect that a mass of water with its density increased because of temperature or salinity. It is possible that these water masses which are presumed to flow in these channels are in part impelled by, and possibly initiated by a water mass with low temperature and/or high salinity, but sediment must be a contributing factor in order to account for the build up of the leveed banks.

Referring to Fig. 1, it can be seen that the topography of the Bay of Bengal is extremely simple. It has the form of a smooth southward sloping plain with a gradient of about 1 fathogram per mile. This simplicity of shape suggests that the sea floor here has been tectonically stable for a long period of time and that the initial tectonic irregularities have been largely masked by sedimentation. The uniform gradient suggests that this gradient is determined by the profile of equilibrium of some sea floor process. Could not this process be turbidity currents? If so, one would expect a north-south system of channels to be present throughout the entire Bay of Bengal. Is it not even possible that *Able* is a channel continuing northward, normal to be region slope, and eventually tying into the mouth of the enormous Ganges submarine canyon 1,100 nautical miles away. This possibility is made more plausible when one considers that *Able* is about eight times as wide and five times as deep as the Mississippi is (below its raised sides) in the vicinity of New Orleans.

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# LETTERS TO THE EDITOR

## PHOTOELASTIC BEHAVIOUR OF SOME CUBIC CRYSTALS

IN continuation of the investigations on the photoelastic effect in crystals, reported in earlier communications, crystals of strontium nitrate, chrome alum, thallium alum and a mixed alum composed of potassium and ammonium alums, all belonging to the $T_h$ class, have now been studied. The differences between the stress-optical constants in units of $10^{-13}$ C.G.S., as determined by a Babinet compensator, are as follows:

| | $q_{11} - q_{12}$ | $q_{11} - q_{13}$ | $q_{44}$ |
|---|---|---|---|
| Strontium nitrate | $-15 \cdot 95$ | $-11 \cdot 27$ | $-1 \cdot 38$ |
| Chrome alum | $-5 \cdot 70$ | $-4 \cdot 98$ | $-1 \cdot 14$ |
| Thallium alum | $-5 \cdot 72$ | $-4 \cdot 65$ | $+0 \cdot 81$ |
| Potassium-ammonium alum | $-5 \cdot 06$ | $-4 \cdot 51$ | $-1 \cdot 02$ |

These constants are for the sodium D lines in all cases except chrome alum for which the wavelength of the light used is 6,850 Å.

Values given above for strontium nitrate are similar to those obtained in barium nitrate[1] and lead nitrate,[2] as may be expected. The behaviour of chrome alum and mixed alum is similar to the alums[3] studied earlier. But the photoelastic behaviour of thallium alum is exceptional in that $q_{44}$ is positive, whereas all the other alums studied so far have a negative $q_{44}$. This abnormal behaviour is probably due to the large atomic weight of thallium. This result is somewhat similar to the positive value of $q_{44} = q_{11} - q_{12}$ in glasses with large lead content, first noticed by Pockels.[4]

Physical Laboratories,    S. BHAGAVANTAM.
Osmania University,    K. V. KRISHNA RAO.
Hyderabad,
*June 25, 1954.*

1. *Nature*, 1948, **162**, 740.
2. *Ibid.*, 1953, **172**, 415.
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# THE BAND SPECTRUM OF MOLYBDENUM OXIDE

IN continuation of the work on the bands of tantalum oxide carried out in this laboratory,[1] investigation on the bands of other heavy oxides was undertaken. The bands of molybdenum oxide have not as yet been recorded, though Piccardi[2] described having observed a continuum from 6,600 Å to 4,800 Å with two intensity maxima at 6,300 Å and 5,220 Å. One of these (at 6,300 Å) showed according to him a feeble group of bands in the arc.

The spectrum of an arc between 'specpure' molybdenum rods at 3–6 amperes and a voltage of 110 was photographed in the region 9,000–6,400 Å by one of us (S. G. K.) in the Astrophysics Laboratories of the Imperial College, London; and an arc at the lowest currents possible (as low as 0·5 amp.) was photographed in the visible and infra-red (8,200–4,500 Å) in this laboratory by the other (T. M. S.).

The spectrum was rich in red-degraded bands throughout the region investigated. The band heads were reduced by measurements made with an Abbe comparator. As many as ten band systems with values of $\omega_e''$ equal to 940, 950, 960 wave numbers were recognised. This value of the vibrational frequencies (of the ground electronic levels?) is comparable with corresponding values obtained with the oxide molecules of the same and neighbouring chemical groups. The intense band heads at wave-numbers 11606, 16089, 16425, 16008, 16365·6,

16445, 16592, 15693 and 16692 form the (0, 0) band heads of the corresponding Deslandre's schemes. Full details will be published elsewhere.

Physics Dept.,    T. M. SWAMINATHAN.
Presidency College,    S. G. KRISHNAMURTHY.
Madras, *July* 5, 1954.

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# AMPEROMETRIC TITRATION OF THORIUM WITH FLUORIDE

THE method described in this note is an application of the indicator technique[1] to the amperometric estimation of thorium. It is based on the fact that when a fluoride solution is added to a solution containing thorium and ferric ions, all the thorium is precipitated before any reaction takes place between the ferric ions and the fluoride ions.[2]

Using a manual polarograph with a dropping mercury electrode and the usual H-shaped cell connected through an agar bridge to a saturated calomel electrode, standard solutions of thorium nitrate (pH 2–2·4) were titrated at 0 volts *vs.* S.C.E. with fluoride solutions of known concentrations in the presence of 0·2 M sodium perchlorate as the supporting electrolyte and 0·001 M ferric perchlorate as the indicator. The capillary had a drop-time of 4·0 sec. and delivered 1·469 mg. of mercury per sec. in a solution—0·2 M in sodium perchlorate, 50 per cent. in alcohol and 0·001 M in ferric perchlorate at 0 volts *vs.* S.C.E. $m^{2/3} t^{1/6}$ equalled 1·629 mg.$^{2/3}$ sec.$^{1/2}$. The fluoride solution was prepared from pure sodium fluoride (E. Merck) and was standardised amperometrically by the well-known methods.[3,4] The titrations were performed in 50 per cent. alcohol medium. The end point of the titration was reached when the current, which initially remained constant but decreased rapidly towards the end, finally became zero. In practice the titrant was added until the current became negative.

The total amount of thorium in solution was calculated as:

mg. of Th in solution = 58·05 VM

where M is the molarity of the fluoride solution and V is its volume in ml. corrected for the amount of iron added.

For the range of 0·6 mg. to 10 mg. of thorium in solution it was found that the error in thorium estimation was not more than 2 per cent. It was found necessary to free the thorium

solution of excess mineral acids and their salts.

M. SUNDARESAN.

M. D. KARKHANAVALA.

Chemistry Division,
Atomic Energy Commission,
Bombay, *May* 15, 1954.

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## CHAIN TRANSFER REACTIONS IN ADDITION POLYMERIZATION OF STYRENE

FLORY[1] first suggested the idea that a solvent might terminate the growing polymer chain and the resulting solvent radicals initiate secondary polymerization. Such a conception explained the constancy of overall rate and decrease in the size of the molecule for the polymerization of certain monomers in the presence of the solvents. Chain transfer reactions with especially aromatic hydrocarbons and aliphatic chlorinated hydrocarbons in the polymerization of styrene have been reported by Mayo and his associates[2-7] and to a little extent in the polymerization of methyl methacrylate by others.[8,9] Isomeric aliphatic alcohols, acids and ketones in the presence of catalysts have not yet been completely studied as 'chain transferring' solvents.

Mayo's equation,

$$1/\overline{DP} = 1/\overline{DP}_0 + C[S/M],$$

(where $\overline{DP}$ and $\overline{DP}_0$ are the degrees of polymerization in bulk and solution reactions respectively, $C = k_{fs}/k_p$; $k_{fs}$ the transfer rate constant for the solvent, $k_p$ the chain propagation rate constant and [S] and [M], the concentrations of solvent and monomer respectively,) in its various modified forms has been extensively employed to evaluate graphically the Chain Transfer Constants, C. When the concentration of the solvent as well as the degree of polymerization are high, Mayo's equation reduces to

$$1/\overline{DP} = C[S/M] = dS/dM \text{ or, } C = \frac{d \log [S]}{d \log [M]}.$$

But if the degree of polymerization is low in the presence of excess of solvent.

$$\overline{DP} = \frac{[M]}{C[S]} + 1 = \frac{d[M]}{d[S]}.$$

In the presence of a catalyst which does not react with the solvent and if the primary initiation is unimolecular,[10]

$$\frac{1}{\overline{DP}} = K\left[\frac{B}{M}\right]^{\frac{1}{2}} + \frac{k_{fm}}{k_p} + \frac{k_{fs}}{k_p}\left[\frac{S}{M}\right]$$

but if the initiation is bimolecular,[11]

$$\frac{1}{\overline{DP}} = K'\left[\frac{B}{M}\right]^{\frac{1}{2}} + \frac{k_{fm}}{k_p} + \frac{k_{fs}}{k_p}\left[\frac{S}{M}\right]$$

where K and K' are constants, [B], the concentration of the catalyst and $k_{fm}$ the transfer rate constant for the monomer with the chain. Following Melville's[12] arguments for transfer reactions in catalyzed photochemical polymerization of vinyl acetate it is easy to derive for uncatalysed thermal polymerizations,

$$R = [M][\text{Starting rate}]^{\frac{1}{2}}\left\{\frac{k_p}{k_t} + \frac{k_{fm}}{k_t} + \frac{k_{fs}}{k_t}\left[\frac{S}{M}\right]\right\}$$

where R = overall rate and $k_t$, the normal termination rate constant.

We have studied transfer reactions in the polymerization of styrene at 60° C. in the absence as well as the presence of a catalyst, benzoyl peroxide. The results have been examined in the light of the equations given above. The following transfer constants, C, have been obtained from the slopes of the graphs (Figs. 1 and 2), $1/\overline{DP}$ vs. [S/M]. (i) For uncatalyzed reactions (Fig. 1)—n-butanol ($16 \times 10^{-5}$), isobuta-
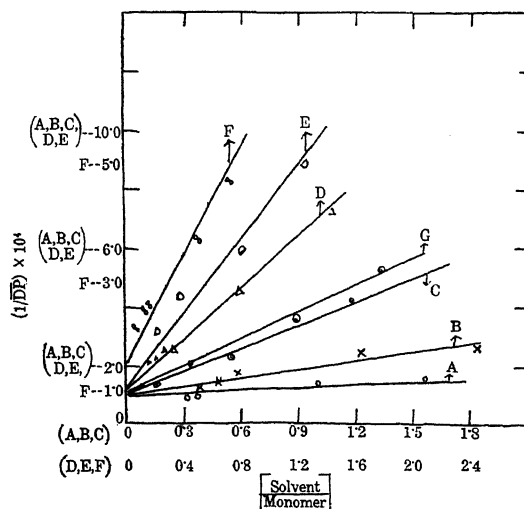


FIG. 1. The linear relationship between the reciprocal degree of polymerization ($1/\overline{DP}$) of styrene at 60°C. and the ratio, [solvent] : [Monomer], with isobutanol (A), acetic acid (B), Diethyl ketone (C), Propionic acid (D), tertiary butanol (E), isobutyric acid (F) and n-butanol (G).

nol ($1\cdot7 \times 10^{-5}$), tertiary butanol ($66\cdot5 \times 10^{-5}$) acetic acid ($10 \times 10^{-5}$), propionic acid ($46 \times 10^{-5}$), isobutyric acid ($46 \times 10^{-5}$), Diethyl ketone ($26 \times 10^{-5}$), and (ii) for catalyzed reactions, (Fig. 2)—acetic acid ($20 \times 10^{-5}$), propionic acid ($43 \times 10^{-5}$), isobutyric acid ($25 \times 10^{-5}$),
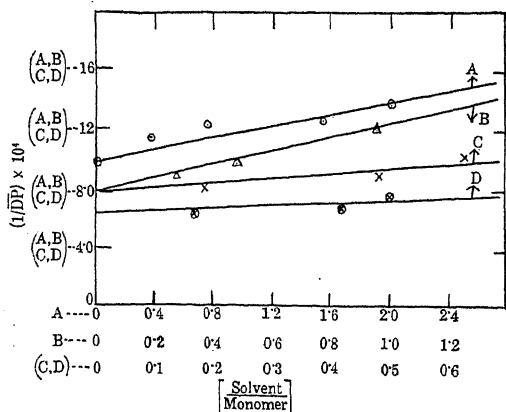


FIG. 2. The linear relationship between $1/\overline{DP}$ vs. [S/M] in the polymerization of Styrene at 60°C., catalyzed by benzoyl peroxide, Bz, with acetic acid (graph A; Bz = $3\cdot4 \times 10^{-3}$M), propionic acid (graph B; Bz = $8\cdot5 \times 10^{-3}$M), Isobutyric acid (graph C; Bz=$8\cdot5 \times 10^{-3}$M), and Normal Butanol (graph D; Bz = $1\cdot14 \times 10^{-2}$M).

and $n$-butanol ($16 \times 10^{-5}$). It has also been found with acetic acid in the absence of any catalyst, (a) the relationship between $R/[M]^{3/2}$
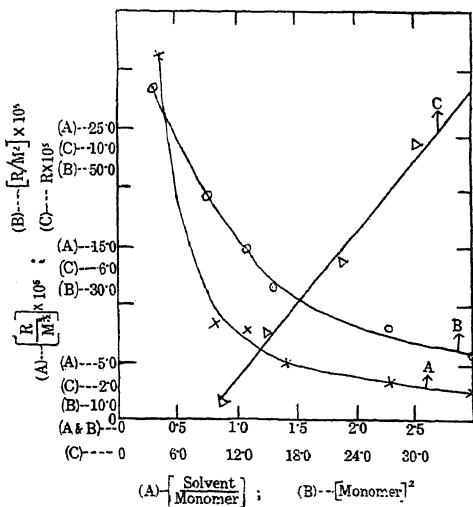


FIG. 3. Graph A shows the nonlinear relationship between overall rate/$[M]^{3/2}$ and [Solvent/Monomer] in polymerization of styrene at 70° C. with Acetic acid as the solvent and graph B indicates similar non-linearity for overall rate/$[M]^2$ and [Solvent/Monomer]. Second order nature of the overall rate constant is seen by the plot C (overall rate against $[M]^2$).

and [S/M] (unimolecular starting rate) as well as $R/[M]^2$ and [S/M] (bimolecular starting rate) fail to follow linear laws (Fig. 3, graphs A & B), and (b) the second order nature of the overall rate constant (Fig. 3, graph C).

The higher as well as lower values of C in catalysed reaction, (ii) above, than in the uncatalyzed reactions, (i) must be explained on the basis of catalyst interactions with the solvents and the failure to follow linearity in (a) above must be traced to the inertness or slowness of solvent radicals for secondary initiation. Complete experimental details with a full discussion will be published elsewhere.

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## OPERATING CELL-CHARACTERISTICS IN THE ELECTRO-WINNING OF MANGANESE

DESCRIBING the data on the production of electrolytic manganese, Dhananjayan, Chakrabarti and Banerjee[1] summarised the optimum conditions for the electrolysis as follows:

Current density, 26·4 amps./sq. ft.; temperature, 32-35° C.; manganous sulphate in the feed electrolyte, 80 g./litre; ammonium sulphate, 150 g./litre; sulphur dioxide, not less than 0·15 g./litre; and catholyte pH, 7·2.

As they confined themselves to laboratory-scale work involving the use of chemically pure salts, *viz.*, manganous sulphate and ammonium sulphate and the usual 12-volt accumulator for passing the current, they observed that "though it is not possible to arrive at the optimum current density without pilot-plant studies, it is safe to assume that it should not be lower than 25 amp. per sq. ft.",

During the past few months, a semi-pilot-plant unit (capable of producing 10 lb. of manganese metal per day) set up in our laboratories has been successfully in operation ; and we have found that a current density of 50 amp. per sq. ft., which is approximately double the c.d. indicated by Dhananjayan and co-workers, could be used, without detriment to either the nature of the manganese deposit or the current-efficiency. Using this current density, the cell was capable of precise and perfect control in respect of all the other variables and a current efficiency of 62·7 per cent. was attained. The advantages of using as high a current density as possible, consistent with a not too difficult operational-control, are obvious, as far as the economics are concerned. It may be pointed out that the c.d. of 50 amp. per sq. ft. is also in conformity with the general American practice.[2-4]

As regards the concentration of manganous sulphate in the feed electrolyte, the value of 80 g. per litre mentioned by Dhananjayan and co-workers, which works out to 29·3 g. of manganese per litre, is lower than that adopted in American practice, which is usually in the range 32-36 g. per litre. In our own semi-pilot-plant trials, we could confirm 32-37 g. of manganese per litre as the optimum concentration in the feed electrolyte for best results ; and it may be observed that a comparatively high concentration of manganous sulphate in the feed electrolyte is conducive to greater economies in the leaching and purification operations.

The authors have pleasure in expressing their sincere thanks to Dr. B. B. Dey, for his keen interest in this work and for his kind and constant encouragement.

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## AN INEXPENSIVE ELECTRONIC RELAY

WORK in these laboratories on reaction kinetics and dielectric constants required the construction of reliable thermostats for which a good electronic relay was needed. The accompanying circuit diagram is given for the convenience of others who might need similar relays.

The relay uses only readily available radio components and can be easily set up. Combined with a double-bulbed toluene thermo regulator, the relay can be safely used to break the mains heater circuit through which a current of 3 amperes is flowing, while the current through the regulator is so small that a thermostat has been working in these laboratories for several months continuously without any tarnishing of the mercury contacts.

The relay was a 117 L 7 type rectifier amplifier tube directly on the 220 volt AC mains with a 1,500 ohm main cord dropping resistance, eliminating the use of a transformer. The advantage of this type of tube is the provision of a plate current of 45 ma. at a relatively low voltage of 110 V. besides providing a fixed rectified grid-bias voltage.[1] A wide range of tubes of similar rating can be used. Any ordinary relay of the post office type having a resistance of about 200 ohms serves satisfactorily and it has been found that when the regulator closes, the current through the relay coil is only about 20 ma. A lower plate current can be got by using as an alternative to the connections shown a link up of the screen to the plate.

The resistance 'X' indicated in the figure depends on that of the relay used and is generally found satisfactory if it is six times that of the relay. The advantage of a make and break type of relay is that the heater can be initially either in the 'on' or the 'off' position without change of circuit.
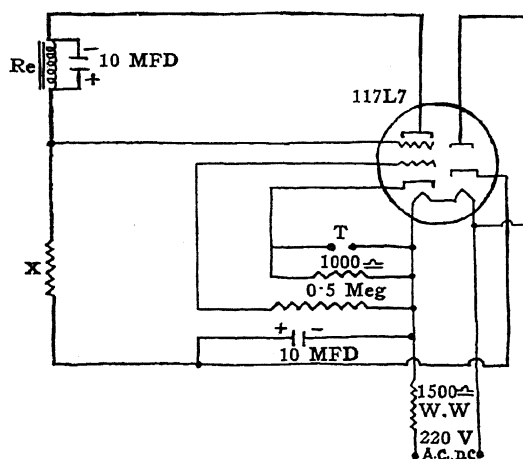


*Re*—Relay of about 1000 ≏ Resistance
*T*—Thermo Regulator
*X*—W.W. Resistance the value of which depends on the Relay Resistance

Thyratrons have been used with sufficient current-carrying capacity to handle directly the control of the heating circuit without the use

of any relay[2] but besides being expensive it has been shown[3] that their effective life is comparatively short.

Using the circuit given and with properly stirred thermostats well insulated thermally from the surroundings, temperature control to within 0·005° C. has been possible and the accuracy is maintained over several months of continuous use. The maximum temperature up to which these have been tried till now is 65° C. and tests at higher temperatures are in progress.

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## ESTIMATION OF DIHYDROXYSTEARIC ACID IN CASTOR OIL

Dihydroxystearic acid[1,2] occurs to a small but significant extent among the fatty acids of castor oil and it has been shown[3,4] to have the two hydroxyl groups in adjacent (9 : 10) positions. Usually, its content in the oil is calculated by difference,[5] though a method[6] to estimate it gravimetrically by its insolubility in ethyl acetate at 0° C. has also been suggested. Such compounds having adjacent hydroxyl groups can be conveniently estimated by oxidation with periodic acid or potassium periodate. G. King[7] has proposed a method using potassium periodate at pH 8, isolating the resulting aldehyde by steam distillation and measuring its volume. Results of the order of 82-95 per cent. have been obtained with a synthetic dihydroxystearic acid (m.p. 132° C.) prepared by the oxidation of oleic acid. This method is obviously not suitable for accurate estimations as it gives low results and is also elaborate.

Preliminary experiments in the present investigation with a dihydroxystearic acid (m.p. 131-32° C.) for varying conditions of time of contact, excess periodic acid, etc., showed that it can be estimated quantitatively in 5-10 minutes using 50-100 per cent. excess of periodic acid. In the presence of unsaturated acids such as oleic acid, groundnut oil fatty acids, ricinoleic acid and linseed oil fatty acids higher results were obtained, while in the presence of stearic acid quantitative results were obtained. Therefore to estimate dihydroxystearic acid in castor oil with periodic acid it is necessary to hydrogenate the oil to a very low iodine value. This is easily achieved by hydrogenating castor oil with Raney nickel (6 per cent. added in two portions of 3 per cent. each at intervals of 5 hours) at room temperature (30-33° C.), under a pressure of 40-42 lb./sq. inch, using alcohol as solvent. Hardened castor oil having iodine value of 6-8 was thus prepared without affecting the hydroxyl group. As the hardened oil is likely to contain small proportions of mono- or diglycerides, estimations were carried out on the methyl esters of the hardened oil.

The procedure for estimation consists of reacting 1-2 g. of the methyl esters dissolved in 10 ml. of glacial acetic acid with 5 ml. of M/25 periodic acid in glacial acetic acid for 10 minutes at 15-20° C. At the end of this period 25 ml. of 10 per cent. potassium iodide solution and 10 ml. chloroform are added and the liberated iodine titrated against standard 0·1 N thiosulphate. A blank experiment is conducted under identical conditions. From the difference between the blank and sample readings the quantity of dihydroxystearic acid is calculated. Results obtained with three samples of castor oil were 2·7, 2·2 and 1·8 per cent. respectively.

These values for dihydroxystearic acid in castor oil are slightly higher than those reported by earlier workers (0·6-1·3 per cent.), but as they are obtained by direct estimation they are likely to be truly representative. A detailed account of these investigations will be published elsewhere.

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## A NEW SYNTHESIS OF BENZO-SELENOPHENE

BENZOSELENOPHENE (I) has been synthesized by the following methods: (a) reaction of acetylene and selenium at 250-300°, when (I) is formed along with selenophene;[1] (b) by the action of potassium ferricyanide on o-seleno-cinnamic acid;[2] and (c) by the reduction of 3-hydroxybenzoselenophene with sodium amalgam and aqueous alcohol.[3] The last method gives 58 per cent. yield of (I), but the yield in the first two methods is not reported. We have now synthesized (I) in two steps starting from selenophenol and bromoacetaldehyde dimethyl acetal in a manner analogous to the general synthesis of thiophenes and thiapyrans described by us earlier.[4]
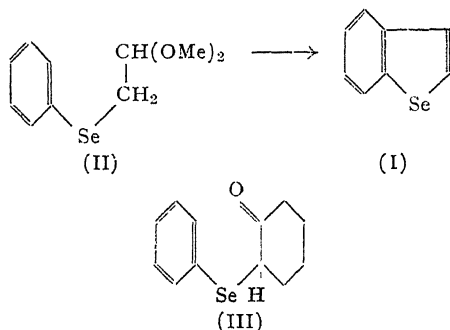


Selenophenol (9·5 g.) was added to an alcoholic solution of sodium ethoxide (1·5 g. of sodium in 50 ml. ethyl alcohol). Bromoacetaldehyde dimethyl acetal (11 g.) was added and the mixture was heated under reflux for 1½ hours. Throughout the experiment hydrogen was bubbled through the reaction mixture. After removal of alcohol by distillation, the reaction mixture was diluted with water and ether-extracted. The extract, after removal of the solvent, gave a brown oil (15·13 g.) which on distillation gave phenyl ω-dimethoxyethyl selenide (II) as a pale yellow liquid (10·3 g., yield 70 per cent.), b.p. 118°/1·1 mm. The 2 : 4-dinitrophenylhydrazone from (II) crystallized from ethyl alcohol-ethyl acetate mixture in bright orange needles, m.p. 149-50°.

Compound (II) (2·8 g.) was cyclized by treatment with a mixture of phosphorus pentoxide (12 g.) and phosphoric acid (sp. gr. 1·75) (8 ml.), under vacuum (5 mm.) at 140-50° in a manner similar to the cyclization of phenyl ω-dimethoxyethyl sulphide.[5] The yellow liquid distillate (0·4 g.) solidified on keeping. The product after purification through the picrate and subsequent distillation gave a colourless liquid, b.p. 130° (bath temp.)/5 mm. (0·21 g.) which later solidified into shining plates, m.p. 49·5-50·5° (literature,[3,1] 51°, 54°). The picrate from (I) gave golden yellow needles from alcohol, m.p. 154-55° (literature,[3] 156-57°). The phosphoric acid residue on ether extraction gave diphenyl diselenide and a resinous product. Attempts to improve the yield of (I) by the use of lower temperatures or by treatment with the above cyclizing agents in benzene were unsuccessful. The synthesis of dibenzoselenophene from selenophenol and 2-bromocyclohexanone (cf. synthesis of dibenzothiophene reported by us earlier[6]) was next undertaken.

Selenophenol (9·5 g.) was dissolved in 50 per cent. aqueous sodium hydroxide (4·8 ml.; 1 mol) and alcohol (20 c.c.) at 20°. 2-Bromocyclohexanone (11·6 g.) was run in slowly over 10 minutes under stirring, and the mixture was agitated for 1 hour. Hydrogen was passed through the reaction mixture throughout the experiment. Orange-yellow crystals separated which proved to be diphenyl diselenide. After separating the diselenide by filtration, the filtrate was shaken with ether and the ether-extract was washed with aqueous alkali, water and then dried. Removal of ether gave an oil which when distilled gave 2-phenyl-selenocyclohexanone (III) as a brown-coloured oil (3·5 g., yield 23 per cent.), b.p. 155-60°/1 mm. The 2 : 4-dinitrophenylhydrazone from (III) crystallized in minute orange-yellow needles, m.p. 169-71° from ethyl alcohol-ethyl acetate mixture.

The cyclization of (III) to tetrahydrodibenzoselenophene by treatment with phosphorus pentoxide-phosphoric acid mixture at 160-70° under vacuum and also in boiling benzene, anhydrous oxalic acid, fused zinc chloride, sodium acetate and acetic anhydride has proved unsuccessful so far.

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# CONDENSATION OF ACETONE WITH ALDEHYDES AND AMMONIA

NOLLER AND BALIAH[1] condensed several ketones with aldehydes and bases in acetic acid medium to get substituted 4-piperidones. Later the reaction was extended to more ketones.[2,3] The ketones used were all of the aliphatic series. Significantly, acetone alone could not be successfully condensed. Hence it appeared to be of interest to find conditions under which acetone also could be condensed, since such a condensation would yield 4-piperidones with no substituents in the 3- and 5-positions. On further experimentation, we found that acetone can also be made to condense with several aromatic aldehydes and ammonia, if the latter is used as acetate and if ethanol is used as the solvent. All aldehydes except benzaldehyde gave the expected piperidone (I) only.

(I)
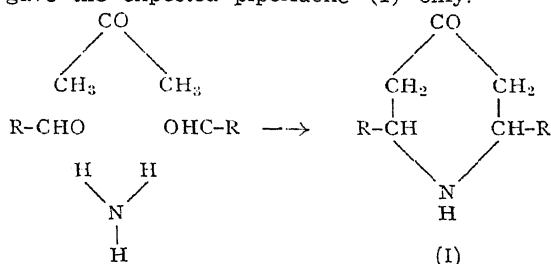
With benzaldehyde, the reaction proceeded a step further to give 2, 4, 6, 8-tetraphenyl-9-ketobispidin (II) as a byproduct.
Similar bispidins were obtained by Mannich and his co-workers[4,5] by condensing 4-piperidones, having reactive hydrogen atoms in 3- and 5-positions, with formaldehyde and methylamine.

The general experimental procedure adopted for the condensations was as follows: a mixture of dry acetone (1 mole), the aldehyde (2 moles) and ammonium acetate (1 mole) in 100 c.c. of ethanol was heated until the acetate dissolved and a yellow colour developed. After cooling, the reaction mixture was taken in ether (500 c.c.) and concentrated hydrochloric acid (50 c.c.) was added. The precipitated hydrochloride was recrystallised from ethanol-ether or acetic acid-ether mixture. The base was liberated with ammonia and recrystallised from ethanol. The relevant data on the 4-piperidones prepared are given in Table I. The quantities within brackets are those calculated from the formulas.

In the case of benzaldehyde the bispidin (14·8 g.) separated on adding ether to the reaction product. Recrystallisation from chloroform gave colourless prisms, m.p. 234-36° (Found: C, 83·7; H, 6·5; $C_{31}H_{28}ON_2$ requires C, 83·8; H, 6·3 per cent.).

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(II)

## TABLE I
### 4-Piperidones (I) and Hydrochlorides

| R | | Hydrochlorides | | | | Bases | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Yield % | M.P. °C. | Formula | Analyses % Cl⁻ | M.P. °C. | | Analyses % | |
| | | | | | | | C | H |
| $C_6H_5$ | 22 | 217 (d) | $C_{17}H_{18}ONCl$ | 12·3 (12·3) | 105 | 81·2 (81·3) | 6·9 (6·8) | |
| $p$-Cl·$C_6H_4$ (a) | 20 | 208 (d) | $C_{17}H_{16}ONCl_3$ | 9·7 ( 9·9) | 108 | 63·5 (63·8) | 4·3 (4·7) | |
| $p$-$CH_3O$·$C_6H_4$ | 38 (b) | 195 (d) | $C_{19}H_{22}O_3NCl$ | 10·5 (10·2) | 145 | 73·2 (73·3) | 7·0 (6·8) | |
| $o$-$CH_3O$·$C_6H_4$ | 20 | 178 (d) | $C_{19}H_{22}O_3NCl$ | 9·9 (10·2) | 154 | 73·4 (73·3) | 6·7 (6·8) | |
| 3, 4-$CH_2O_2$ : $C_6H_3$ | 35 | 196 (d) | $C_{19}H_{18}ONCl$ | 9·2 ( 9·5) | 151 | 67·0 (67·3) | 5·2 (5·0) | |

(d) = with decomposition;    (a) The base was recrystallised from pyridine-water.    (b) The molar ratio of acetone : anisaldehyde : ammonium acetate was 2 : 1 : 1.

## ISOLATION OF PURE CARDOL FROM INDIAN CASHEW NUT SHELL LIQUID AND NATURE OF ITS OLEFINIC UNSATURATION

ALTHOUGH cardol, isolated from solvent extracted cashew nut shell liquid by the lead salt method and purified by vacuum distillation, was found to absorb hydrogen equivalent to about 2·5 double bonds per mole,[1,2] still it was assumed to contain only 2 double bonds, the extra hydrogen absorbed being attributed to the presence of highly unsaturated impurities, and assigned the structure, 5-pentadecadienyl resorcinol.[1] Attempt has now been made to find out the nature of the alleged impurities and to obtain pure cardol in order to determine the exact number of double bonds and their relative position in the aliphatic side chain.

A sample of cardol, isolated from Indian cashew nut shell liquid by the above method, yielded on vacuum distillation (pressure 2 mm. and temperature range 200-30° C.) 5 fractions with decreasing number of double bonds, *i.e.*, from 2·42 to 2·15. The hydrogenated products of the first 3 fractions, on repeated crystallisation, gave as the major component 3-pentadecyl phenol, m.p. 52-53° C.,[3,4] whereas those of the last two fractions yielded 5-pentadecyl resorcinol, m.p. 95-96° C.,[1,2] so that the cardol sample contained actually, as impurity, a certain amount of the di- and tri-olefinic components of cardanol,[4,5] thus accounting for more than the theoretical amount of hydrogen absorption observed by earlier workers.

In order to free the cardol sample of its monophenolic impurities, it was subjected to molecular distillation at $10^{-4}$ mm. Hg. The first 4 fractions were again found to be mixtures of cardol and cardanol, whereas the last fraction contained over 98 per cent. cardol as evaluated by the acetyl value, 10·5, and the melting point, 93-94° C. (purified compound, 95-96°) of the unpurified hydrogenated product, and possessed 2·04 double bonds per mole.

Oxidation of this pure cardol with potassium permanganate in acetone at low temperature yielded azelaic, oxalic and butyric acids; its dimethyl ether on similar treatment gave butyric, oxalic and ω-(3, 5-dimethoxy phenyl) caprylic acids. In terms of these observations, the following structure is proposed for cardol:
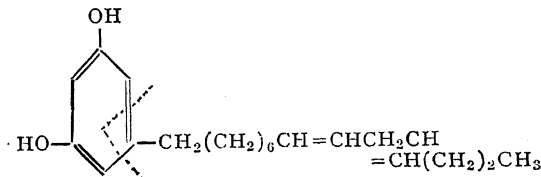


in which the dotted lines indicate the cleavage points of the aromatic nucleus during oxidation leading to azelaic acid. Further, as is evident from this structure, its dimethyl ether can suffer fission, on mild oxidation, only at the double bonds in the side chain, yielding, on the one hand, the aromatic substituted fatty acid, and on the other, butyric acid and oxalic acid which is known to result from the oxidation of fatty acids with the structure
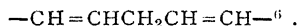
$$-CH = CHCH_2CH = CH-[6] \; .$$

Full details of this investigation will be published elsewhere.

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## ISOLATION OF LYCORINE FROM *CRINUM DEFIXUM* KER-GAWL

FROM *Crinum asiaticum* L. var. *japonicum* Bak., Kinzi Tanaka[1] isolated lycorine (narcissine), $C_{16}H_{17}NO_4$, m.p. 275° and crinamin, $C_{16}H_{16}NO_3$ (OMe), m.p. 193-94°. From *Crinum scabrum* Benno Reichert[2] isolated the former alkaloid. Recently Hunger and Reichstein[3] have described the isolation of lycorine from a *Crinum* species of African origin, probably *Crinum firmifolium* Baker. We have now investigated the active principles of *C. defixum* Ker-Gawl, a plant indigenous to India and Ceylon and found that it also contains lycorine and that this alkaloid can be isolated with relative ease.

The bulbs were freed from scale leaves and minced. The juice that exuded was discarded. The residual minced mass was allowed to ferment for 48 hours at room temperature and then extracted with alcohol by cold maceration. After treatment with freshly precipitated lead hydroxide it was filtered and the filtrate

adjusted to pH 6. It was concentrated to about 15 per cent. of its original bulk and extracted successively with petroleum ether and ether, and after further concentration to remove all alcohol, with chloroform and chloroform-alcohol (2 : 1). Crystalline lycorine was obtained by direct crystallisation of the ether extract, the chloroform extract and the chloroform-alcohol (2 : 1) extract. The amorphous mother liquors of the chloroform extract and chf-alc. (2 : 1) extract were divided into basic and neutral fractions. From both the basic fractions some more lycorine was obtained. The original aq. liquid was made alkaline with $K_2CO_3$ and again extracted with chloroform and chf-alc. (2 : 1). Both the extracts again yielded crystalline lycorine without difficulty. A total of 2·14 g. of crystalline lycorine was obtained from 9 lb. of the fresh bulbs ; out of this quantity 1·74 g. was obtained from the first chloroform-alcohol (2 : 1) extract alone.

The identity of the substance was established by its m.p., optical rotation, by the presence of nitrogen, by a positive gallic acid test for methylene dioxy group and by the preparation of its crystalline di-acetate and hydrochloride. Our data which are in general agreement with those recorded in the literature[1-5] are given below : lycorine : m.p. 272-76° (decomp.) ; $[a]_D$ = − 100° in absolute alcohol and − 78·1° in pyridine ; lycorine di-acetate : m.p. 216-18° ; lycorine hydrochloride : m.p. 225-27° (decomp.).

We thank Mr. B. S. M. Dutt and Prof. J. Venkateswarlu for the supply of authentic plant material. Further details will be published elsewhere.

Pharmacy Dept.,        S. RANGASWAMI.
Andhra University,     E. VENKATA RAO.
Waltair, *June* 12, 1954.

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## LONGIFOLENE

THE author has been engaged for some time on a careful study of the oxidative degradation of longifolene. In 1953 three simultaneous papers[1] relating to the structure of longifolene appeared and very recently a fourth paper[2] has been published. The results obtained by the author are therefore now placed on record.

The chromic acid-acetic acid oxidation product yielded a 'phenolic body' (m.p. 130-31°)

on saturating the dilute sodium hydroxide extract with carbon dioxide. The phenol yielded a methyl ether (b.p. 128-29°/4 mm.) and an ethyl ether (b.p. 153-55°/4 mm.) on alkylation in acetone solution in presence of potassium carbonate. Oxidation, under specific conditions, of d-longif-1 : 2-dione[3] with hydrogen peroxide afforded an acid of m.p. 216-18°.

In view of the announced field of attention by other workers, it is proposed to confine our work to the phenol and the acid obtained here.

Dept. of Chemistry,        K. N. MENON.
University of Madras,
Madras-25, *July* 8, 1954.

1. Moffett, R. H. and Roger, D., *Chem. and Ind.*, 1953, 916 ; Naffa, P. and Ourisson, G., *Ibid.*, 1953, 917 ; Ourisson, G., *Ibid.*, 1953, 918
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## PAPER CHROMATOGRAPHY OF PTEROYLGLUTAMIC ACID

THE separation and identification of all the vitamins of the B-group excepting pteroylglutamic acid (PGA), from a mixture containing all the B-group vitamins was reported earlier by Radhakrishnamurty and Sarma,[1] using the technique of ascending paper chromatography. PGA was chromatographed by Nichol and co-workers[2,3] by running the chromatograms with 0·1 M phosphate buffer as the solvent and identified by bioautography using *Streptococcus fœcalis* as the test organism. They observed trailing of compounds[2] and spreading out of the spots on the bioautographs because of the diffusion of the compounds through the solid medium.[3] In the present communication a rapid and easy method of identification of PGA is reported. The spots obtained are more compact by this method with phenol as the solvent than those obtained by Nichol and co-workers using buffers at different hydrogen-ion concentrations.

PGA was dissolved in 20 per cent. ethyl alcohol containing 0·01 N sodium hydroxide. The solvent was prepared by saturating 50 ml. of redistilled phenol with 25 ml. of water and the organic phase was employed for running the chromatogram. Ascending type of chromatography[4] was used in these investigations. The solvent front traversed a distance of about 18 cm. in a period of 5 hours. The chromatogram was dried in air at room temperature overnight and the remaining phenol was driven off by keeping the chromatogram in a hot air

oven at 100° C. for 10 minutes and then examined under an ultra-violet lamp. PGA could be identified by its characteristic blue fluorescence[5] but the minimum limit of identification was 5 $\gamma$. The $R_f$ value of pure PGA was found to be $0 \cdot 34 \pm 0 \cdot 02$ at 31° C. Trials to increase the sensitivity by oxidation with potassium permanganate[6] on paper did not give encouraging results and hence a modified procedure based on oxidising PGA prior to spotting on the paper was employed. PGA (1 mg.) was oxidised with 4 per cent. potassium permanganate solution (0·5 ml.) for 10 minutes and the excess of permanganate was destroyed with hydrogen peroxide and made up to a convenient volume (2·5 ml.) and filtered. The filtrate contains the equivalent of 1 mg. of PGA in the form of 2-amino-4-hydroxypteridine-6-carboxylic acid,[7] which gives intense blue fluorescence in ultra-violet light.[6] By running the chromatogram with this oxidation product it was possible to identify very low amounts upto $0 \cdot 1 \gamma$ of PGA using the above-mentioned phenol saturated with water as the solvent. The $R_f$ value of this oxidation product is $0 \cdot 37 \pm 0 \cdot 02$ at 31° C., incidentally very near that of pure PGA. By observing, therefore, under the ultra-violet light it is possible to arrive at an estimate of the PGA content in commercial vitamin tablets. Quantitative determinations by eluting the spots with 4 per cent. sodium tetraborate ($Na_2B_4O_7$, $10 H_2O$) solution and measuring the fluorescence against 0·04 and 0·004 mg. per cent. quinine sulphate solutions as reference standards for the levels 1 to 10 $\gamma$ and 0·1 to 1·0 $\gamma$ of PGA respectively in a Lumetron Fluorimeter using thiocrome filters are also in progress and will be reported in detail elsewhere.

Univ. Biochem. Lab.,    R. RADHAKRISHNAMURTY.
Madras-25,            P. S. SARMA.
*May* 12, 1954.

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## SOME PECULIARITIES IN THE NERVOUS SYSTEM OF *GRYLLOTALPA AFRICANA* BEAUVOIS (ORTHOPTERA)

IMMS[1] recorded that the nervous system of Orthopteroid insects is of a generalised type and in addition to the cephalic centres there are three thoracic and 5 or 6 abdominal ganglia. *Gryllotalpa* is exceptional, and according to Newport[1] in addition to those of the thorax, there are only four ganglia in the abdomen. Thus according to him there are only seven ganglia in *Gryllotalpa*. In fact the nervous system of *Gryllotalpa* is also in full conformity with those of other Orthopteroid insects, because there are eight ganglia besides the cephalic centres. Out of these four are situated in the thoracic region and four in the abdominal region. Each of the pro- and meso-thoracic segments has a single ganglion while the metathorax has two ganglia which are situated very close to each other. The anterior one of these two ganglia primarily innervates the metathorax, is larger and similar in size and shape to those of pro- and meso-thoracic ganglia, while the posterior one innervates the abdominal segments, is smaller and similar to those of other abdominal ganglia. Thus the anterior one is the true metathoracic ganglion, while the posterior one really belongs to the abdomen, and has only migrated to the metathorax. The presence of the two ganglia in one segment is unique and has not been recorded in any other insect. This unique and unexpected feature led Newport to believe that there is only one ganglion in the metathorax as usual and thus he committed the error of noting only seven ganglia. The first abdominal segment also possesses a ganglion and this is unexpected that there can be another ganglion between the metathoracic and the first abdominal ganglia. This unexpected feature led him to believe that there was only one ganglion in the metathorax. On the basis of Newport's observations Imms has wrongly concluded that the nervous system of *Gryllotalpa* is an exception to those found in other Orthopteroid insects.

In higher insects there is a tendency for the nerve ganglia of the abdominal region to migrate to the thoracic region and become fused with the ganglia there. In *Gryllotalpa* the anterior abdominal ganglion has migrated very close to the metathoracic ganglion but actual fusion has not taken place, and therefore, it may be inferred that *Gryllotalpa* is more highly evolved than other Orthopteroid insects.

The nerves from each ganglion consistently go to the segment in which the ganglion had its origin and on this basis the migration of a ganglion is decided in the adult stage, but in *Gryllotalpa* actual migration is seen.



FIG. 1. *g*.1–*g*.5, abdominal ganglia ; *Mes. g*, mesothoracic ganglion ; *Met. g*, metathoracic ganglion ; I–VIII, abdominal segments.

The remaining four abdominal ganglia are situated in the first, third, fifth and eighth abdominal segments.

Snodgrass[2] has recorded that the ganglia are subject to a displacement anteriorly, so that a ganglion belonging to some particular segment may actually lie in a more anterior segment. In *Gryllotalpa*, however, there is a posterior displacement of the ganglion, the ganglion situated in the eighth abdominal segment innervates the seventh segment also, and therefore it may be regarded that to this ganglion the ganglion of the seventh segment has also fused, thus there is a posterior displacement of the ganglion. The posterior displacement of a ganglion has been recorded for the first time.

A detailed account of the nervous system will be published elsewhere.

Dept. of Zoology,      R. RAKSHPAL.<br>The University, Lucknow,<br>*April* 7, 1954.

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### CLEISTOGAMY IN TIL (*SESAMUM ORIENTALE* L.)

CLEISTOGAMY in *Sesamum orientale* does not appear to have been reported so far, although it has often been observed in rice,[1] *oxalis* spp. and some grasses.[2]

Detailed study of these cleistogamous flowers of sesame and their breeding behaviour was made and the observations are summarised below :

Flowers greenish purple and smaller than the normal ones ; calyx green, five sepalous, sessile, lanceolate ; entire with acute apices ; tip of the corolla greenish purple and rest of the flowers never open ; stamens normal, greenish with anther lobes reflexed with broad connective region ; pollen grains usually normal except a few found empty, small and oval in shape ; ovary normal with style persistent, mostly functional except a few non-functional ones. Seed-setting was normal except for a few empty and shrivelled seeds.

Some of the cleistogamous flowers when crossed with the pollen of their sister plants indicated normal fertilization and seed-setting showing two types of fruits : (*i*) normal locular capsules with normal seeds and few empty and shrivelled seeds, (*ii*) normal locular capsules splitting longitudinally at maturity with some ovules replaced by parenchymatous outgrowths bearing glandular hairs. Cleistogamy seems to insure close inbreeding and therefore, the purity of the variety can be maintained without the use of selfing bags and other devices for controlling the hereditary characters.

Agri. Research Inst.,      R. N. SRIVASTAVA.<br>Sabour (Bhagalpur), Bihar,<br>*February* 4, 1954.

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### *NEODIPLOSTOMOIDES MILVII*, N. SP. (FAMILY DIPLOSTOMIDAE : TREMATODA)

A DOZEN specimens of these flukes were collected from the intestine of a common kite, *Milvus migrans govinda*, captured in the suburbs of Allahabad. *Neodiplostomoides milvii*, n. sp. has a broadly elongated body divided distinctly into two parts by a shallow constriction. Forebody possess very minute backwardly-directed spines. It is distinguished by the presence of terminal and circular oral sucker, a transversely elongated acetabulum and a oval holdfast organ with a prominent central aperture. The adhesive glands are present and there are no pseudosuckers. Prepharynx is small. Pharynx muscular and the oesophagus is absent. Hind body is longer than the fore-body. The anterior testis is dumb bell-shaped and the posterior one presents a H-shaped appearance with posteriorly compressed arms. *Vesicula seminalis* is well developed and S-shaped. The oval ovary, with a notch on the anterior margin

lies in the first quarter of the hind body. Wedge-shaped Mehlis's gland is located on the ventral left side of the body. A large hammer-headed genital bulb, characteristic of the genus, is located dorsal to the genital atrium. It covers most of the space of the genital atrium. Vitellaria extends from the level of pharynx to genital atrium. Eggs are few.

*Neodiplostomoides milvii*, n. sp. is distinguished from the only known species *N. mehrii* Vidyarthi (1938) by the presence of vesicular ends at the extremity of each intestinal cæcum, shape of the testes and the *Vesicula seminalis*, shape and position of the Mehlis's gland and the number of eggs present.

The definition of the genus *Neodiplostomoides* Vidyarthi (1938), amended in the light of the present species a fuller description of the new termatode and a definition of the new species will be given in a fuller paper to be published elsewhere.

University of Allahabad,          V. K. SAXENA.
Allahabad, *April* 22, 1954.

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## STUDIES ON THE BREEDING BEHAVIOUR OF *PENNISETUM* (*P. CLANDESTINUM* HOCHST. VAR. *KABETE*)

THE breeding behaviour of the two varieties of *Pennisetum clandestinum*, viz., *Kabete* and *Rongai* is under investigation. The *Kabete* variety with exserted anthers (Fig. 1) and
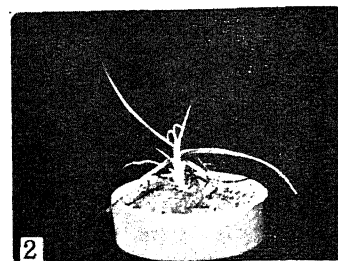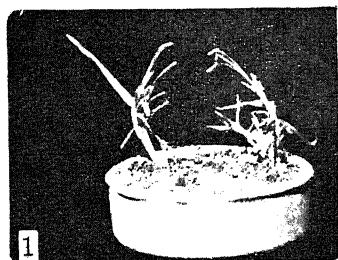




FIG. 1. *P. clandestinum* var. *Kabete*, showing exserted anthers.
FIG. 2. *P. clandestinum* var. *Rongai*, with non-exserted anthers. Shows only the bifid stigma.

good pollen is male fertile and the *Rongai* variety (Fig. 2) with non-exserted anthers and no pollen is completely male sterile.[1] The two varieties were crossed using *Kabete* as the male parent. The progeny resulting from this cross included both male fertile plants resembling the male parent *Kabete* variety, and male sterile plants (maternal) resembling the female parent *Rongai* variety.[1] To explain these results a hypothesis that the *Rongai* variety is a facultative apomict producing the male fertile plants by sexual reproduction, and the male sterile ones by apomixis, was put forth. Cytological evidence showing the formation of both haploid and diploid embryo sacs was adduced in support of that hypothesis.[2] However, the possibility that similar results could be got if *Kabete* variety is heterozygous. (T$t$) for a dominant gene (T) responsible for male fertility and the *Rongai* variety homozygous ($tt$) for its recessive allele ($t$) responsible for male sterility, although in a 1 : 1 ratio, suggested itself. But the difficulties involved in crossing to raise a large number of progeny prevent this suggestion being subjected to a statistical analysis. Nevertheless, the suggestion was verified by selfing the *Kabete* variety for, if *Kabete* variety is heterozygous then on selfing it should seggregate the male sterile *Rongai* variety.

220 selfed seeds of *Kabete* variety were sown. 202 of them germinated and 198 grew to maturity and flowered 5 months later. All these 198 plants resembled *Kabete* variety in forming exserted anthers and good pollen. Since *Kabete* variety also is presumed to be a facultative apomict, at least some of the 198 plants that grew to maturity should have been formed by sexually formed seeds and should have seggregated the male sterile *Rongai* variety if it were heterozygous for male sterility. The absence of seggregants indicates that the *Kabete* variety might be homozygous for the dominant gene responsible for male sterility (TT). However, it is possible to get the same result, *i.e.*, formation of progeny resembling the parent *Kabete* variety, if the latter reproduces exclusively by apomixis in spite of its being heterozygous for male sterility. Since there is no way of distinguishing the sexually formed plants of the homozygous parent variety from the apomictically formed plants of the heterozygous ones, it is not possible to say definitely whether any of these 198 plants are formed sexually. Experiments to determine whether *Kabete* variety is a facultative apomict are in progress and will be reported separately.

Grateful acknowledgement is made to Dr. P. M. N. Naidu and Prof. L. N. Rao for facilities and kind encouragement.

Dept. of Botany,　　　　　K. N. NARAYAN.
Central College, Bangalore-1,
*July* 6, 1954.

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## SEPTATE EPIDERMAL AND COLLENCHYMA CELLS IN THE TENDRILS OF *VITIS REPENS* W. AND A.

IT is well known that even the mature epidermal cells as well as the underlying cortical cells are capable of further division but the divisions in the epidermis are usually by radial walls.[1] In the tendrils of *Vitis repens*, the cells of the mature epidermis divide by radial, periclinal and even oblique walls, giving rise to a septate condition.

Fig. 1 shows in cross-section a part of the epidermis of an old coiled tendril. The outer wall is prominently thickened and cuticularised. The outer and inner angles of the epidermal cells
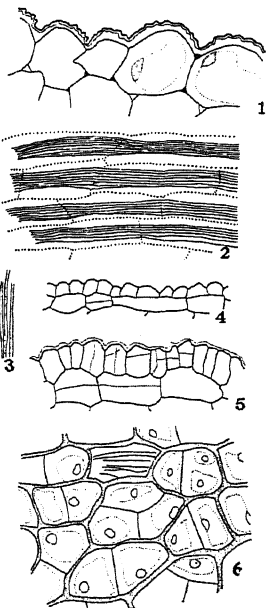


FIG. 1. Portion enlarged from a cross-section of a tendril, × 400.
FIG. 2. Surface view of the epidermis, × 225.
FIG. 3. Longitudinal corrugations of the epidermis, × 375.
FIGS. 4 and 5. Portions of the convex and concave side of a tendril in cross-section, × 165.
FIG. 6. Surface view of the septate epidermis, × 225.

sometimes show collenchymatous thickening. The outer epidermal surface has teeth-like projections, which are normally absent in the basal part of the tendril. In surface view, they appear as longitudinal stripes (Figs. 2, 3). They are most probably connected with the perception of the mechanical stimuli (Haberlandt[2]). Figs. 4 and 5 represent portions of the convex and concave sides of a tendril in cross-section. Some of the epidermal cells of the concave side have divided by thin-walled septa which are radial, periclinal, or oblique. Fig. 6 shows such a septate epidermis in surface view. This condition is probably a structural adaptation of the concave side of the tendril.

The collenchyma cells of the tendril may become septate.

Grateful thanks are due to Prof. P. Maheshwari for suggestions and to Shri I. N. Solanky for facilities.

Biology Dept.　　　　　J. J. SHAH.
M.T.B. College, Surat,
*June* 1, 1954.

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## *RHYNCHAENUS MANGIFERAE*, A SERIOUS MANGO PEST IN THE UTTAR PRADESH

*Rhynchœnus mangiferœ* Mshll, not so far reported from U.P. has attained an epidemic form, specially in the Western Districts of the State. Till now it has been recorded in Ceylon[1] and South India.[2]

The adult commonly known as Flea weevil belongs to the family Curculionidæ. It is 1·7 mm. long and dark brown in colour. The weevil appears in the month of February and remains active upto May. The eggs laid singly in the flowers and occasionally on the lower side margin of the young leaves, hatch in 2-3 days. The tiny white grubs mine the thalmus of the flowers and buds and attain a length of 3 mm. in 3-4 days. Pupation also occurs inside the same. Pupa is 1·7 mm. long and the adult emerges in 2-3 days.

After the bloom is over, the weevil multiplies on malformed inflorescence and young leaves. When the latter are used for egg-laying, the grubs mine the ribs and pupate there.

The affected flowers and buds wither and dry while the latter even do not open. The infesta-

tion is about 40 per cent. and it is particularly severe in Langra variety where it reaches 60-70 per cent. In severe cases, swarms of the weevils have been observed clustering on the inflorescence and tender foliage where they eat the leaf content and leave only the net works of veins. The weevils when disturbed, take only a short flight and settle down readily. There appears to be more than eight overlapping generations during the active period.

The pest has now become fully established and is one of the main reasons of poor setting of mangoes. It needs immediate attention for control.

The author is indebted to Dr. R. N. Mathur of Forest Research Institute, Dehra Dun, for identifying the pest.

Govt. Horticultural Res. Station,    S. M. SINGH.
Saharanpur, U.P., *May* 10, 1954.

1. Hutson, J. C., *Report on the Work of Entomological Division, Adm. Dir. Agric.*, Ceylon, 1931, pp. D111–D121, Colombo.
2. Ramakrishna Ayyar, T. V., *Agric. Res. Inst. Pusa Bull.*, 1922, **125,** p. 21.

## A RAPID COLORIMETRIC METHOD FOR THE EVALUATION OF ORGANIC MATTER OF SOILS

IN the course of field experimental work in the Community Project areas in Madhya Pradesh, it was found necessary to evolve a quick and simple method for the estimation of organic matter in soils, which could readily be applied in places where usual laboratory facilities are not available. A number of modifications of the Schollenberger's[1] method for the rapid estimation of organic matter in the soil, have been developed during the past few years. On the basis of these modifications[2,3,4] a colorimetric method has been worked to serve as a field test for the soils of Madhya Pradesh. The procedure adopted is, in short, as follows:

One flat spoonful (roughly 1 g.) of soil is placed in a hard glass test-tube and to this 2 ml. of 2·5 N potassium dichromate and 2·5 ml. of strong sulphuric acid are added. The tube is shaken up from time to time and allowed to stand for 10 minutes. After the soil settles, 3-4 drops of the upper clear liquid are poured in the depression of a porcelain tile and the colour is matched with the colours of the standard plate.

The standard colour plate was prepared by taking soils with 3, 2, 1·5, 1 and ·7 per cent. of organic matter, treating them by the above method and recording the colours formed. The

colours developed were bright green, dirty yellowish green, dark brown, brownish yellow and reddish brown and could easily be distinguished from each other.

Soils from areas under different crops were examined by this method and the results compared with the Allison's[5] modification. The following table gives the figures of analysis in case of a few samples:

| Description of soil | Percentage of organic matter | |
|---|---|---|
| | By Allison's method ($C \times 1 \cdot 724$) | By present method |
| Orange garden soil, Ubali | 1·35 | 1·5 |
| Soil under cotton from the field of a cultivator, Akola | 0·91 | 1·0 |
| Nagpur College Farm soil under cotton | 1·39 | 1·5–2 |
| Soil from a cultivator growing wheat, Tharsa | 0·67 | 0·7 |
| Baitul Farm soil | 0·68 | 0·7 |
| Soil under paddy from Adhartal Farm, Jabbalpur | 1·48 | 1·5 |
| Wardi soil, Sindewahi | 1·3 | 1·0–1·5 |
| Soil from a cultivator growing paddy, Bhandara District | 1·94 | 1·5–2 |
| Dorsa soil, Raipur | 0·66 | 0·7 |
| Company garden soil, Chanda | 1·19 | 1·0–1·5 |

It will be seen that the values obtained by the above technique compare fairly well with the actual percentages as obtained by Allison's method.

A rough estimate of the percentage of nitrogen in the soil could also be obtained from the organic matter percentage by dividing the figure by 18 ($1 \cdot 724 \times 10 \cdot 11$) and has been found to agree with the percentage of nitrogen actually estimated.

Trials of this method made on fields receiving different manurial treatments have shown that it could very conveniently be used as a rapid field test for finding the organic matter requirement of a soil. A detailed account of this method will be published elsewhere.

The author is thankful to Shri R. C. Shrivastava for his kind interest.

Agric. Res. Institute,    R. H. JOSHI.
Nagpur, *June* 1, 1954.

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2. Thomas, R. P. and Williams, R. C., *Proc. Soil Sci. Soc.*, 1936, **1,** 243.
3. Khanna, K. L., Prasad, S. N. and Bhattacharya, P. B., *Proc. Ind. Acad. Sci.*, 1949, **30,** 11.
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# REVIEWS

**Energy Transfer in Hot Gases.** (NBS, U.S. Dept. of Commerce, Washington 25 D.C.), 1954. Pp. 126. Price $ 1.50.

The book under review is a collection of papers presented at the Symposium on Energy Transfer in Hot Gases, held by the National Bureau of Standards, U.S.A., during 1951, the year of the 50th anniversary of its establishment. The subject is of great importance both from theoretical and practical standpoint, since with this is connected the fundamental problem of the generation and utilisation of energy from combustion processes in means of motive power such as the aero engines, jet engines, rockets, etc.

Appropriately enough, the approach is mainly spectroscopic, since spectral studies have in recent years contributed a good deal to a better understanding of combustion processes. Spectroscopic methods have the great advantage over the chemical ones in so far as they give information about the intermediate products of extremely short life-time without the introduction of extraneous disturbing factors. The spectroscopic data is obtained by first identifying the emitting radicals and secondly by ascertaining the energy state of these radicals by determination of vibrational, rotational and translational temperatures through intensity measurements. Though by now, radicals like OH, CH, $C_2$, $CO_2$ have been identified with complete certainty in hydrocarbon flame spectra, there is one which is still eluding identification and that is the one which gives rise to some 37 bands between 4,100-2,500 Å which were first discovered by the reviewer. They were provisionally attributed to HCO; more work was needed to fix the emitter with certainty. Two papers on this subject, one from the National Bureau of Standards and the other from the Canadian Research Council, giving an account of their recent researches are greatly welcome.

Several papers are devoted to the discussion of equipartion of energy from the measurements of the vibrational and rotational temperatures of the important radical of OH. There are three papers on the new subject of the infra-red spectra of combustion phenomena. From the Johns Hopkins University comes an important paper on the "Energy Distribution of CO Molecules in CO-$O_2$ Flames". Dr. Bernard Lewis gives an excellent summary of the present position of the theories of flames.

To a research worker this collection of papers is of great value, giving an idea of the trend of research on combustion in America and England, where the results obtained have immediate application to aero engines, jet engines and rockets. W. M. VAIDYA.

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**Crystal Structures,** Vol. III. By R. W. G. Wyckoff. (Interscience Publishers, Inc.), 1953. Price $ 14.50.

This volume contains Chapters XIV and XV dealing respectively with benzene derivatives and with alicyclic and heterocyclic compounds, together with carbohydrates. The general plan follows the earlier volumes, each chapter being divided into text, tables, illustrations and bibliography, each section being separately paginated. Although it takes some time to get used to this scheme, the book is quite convenient to refer, once its contents have become familiar.

As the earlier volumes were not reviewed in this journal, it may be worthwhile mentioning that the book has been issued in loose-leaf form, so that future data could be inserted in the appropriate places. While no doubt this is an excellent idea, the device used for keeping the sheets together requires improvement. During the few months that the volume has been in use in the writer's laboratory, the sheets were found to have a tendency to curl up and crease.

Each structure is briefly described in the text with comments on the X-ray data used and the arrangement of the atoms. The first table in each chapter lists all the compounds, together with the information as to where their unit cell dimensions and space group may be found, the page where the structure is described in detail and also the literature reference in brief. Succeeding tables give the space group, crystal axes and number of molecules per unit cell. The illustrations have all been specially drawn for this edition; both projections as well as packing drawings are shown. One cannot but admire the enormous patience and the meticulous care which have been put in for making the volume free from errors and

omissions. Crystallographers owe a great debt of gratitude to Dr. Wyckoff for this gigantic effort of his. These volumes should definitely find a place in every laboratory devoted to crystallography and solid state physics.

G. N. RAMACHANDRAN.

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**Fibre Microscopy.** By A. N. J. Heyn. (Interscience Publishers, Inc.), 1954. Pp. xiii + 407 + xii. Price $ 5.50.

The volume under review is specially intended to introduce the subject of fibre microscopy to the young student and is doubly welcome, since most of the existing handbooks on the subject have been written mainly for research work.

With the influx of synthetic fibres into textile manufacture, a student of textile technology is at present expected to have an elementary knowledge of the physical and chemical characteristics of the various fibres in controlling the manufacturing processes, in testing and in various other problems in the mill, while more advanced knowledge is expected from the research worker. The book serves very well the requirements of both the categories of workers.

The material of the book consists of a general classification of fibres, a detailed description of the microscope including its manipulation and maintenance, preparation of stained and unstained slides of whole fibres and cross-sections, hand and mechanical sectioning, micrometry and recording of observation including photomicrography, various keys for fibre identification, application of polarizing microscope in investigating submicroscopic structure, description of the structure and general characteristics of various fibres and application of special optical methods such as dark field illumination, optical staining and dispersion staining, etc.

In dealing with each of the above aspects, the author has very wisely given the theoretical background of the topic in the beginning, and describes simple laboratory experiments—marking off clearly experiments intended for the beginner from those required for advanced students. The material in each chapter is arranged in a way easy to grasp.

At the end of each chapter a list of references on the topic is given to enable the student to have further knowledge in any particular aspect of the topic in which he may be interested in. The list of reagents, with their methods of preparation and uses, and the photomicrographs of most of the fibres, both lengthviews and cross-sections, are very useful.

In the reviewer's opinion, if the material of the book is arranged in the serial order of Chapters I, II, VI, VIII, X, XII, XIV (General microscopy), III, IV, V, IX, XI, XIII, XV, XVI, XVII, XVIII (Structure and general characteristics of various fibres), XIX (Identification of fibres), XX, XXI, XXII (Polarising microscopy and special optical methods), the material will be easier for the student to digest.          B. C. MOHANTY.

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**A New Periodic Table of the Elements.** By S. I. Tomkeieff. (Chapman & Hall), 1954. Pp. 30. Price 10 *sh.*

The title of the booklet is to some extent misleading. Neither the representation on a cone-shaped surface nor based on the structure of the atom is new, but the combination of the two may be considered a new picture. The publication is a useful essay on the subject, particularly for the theoretical background it provides at the beginning. The tables also give useful information. The author has, however, made statements some of which are controversial and others of doubtful accuracy. For instance, copper is not considered a transition element while silicon is put down as a metal. Meisel has reported on the dimorphic character of scandium in 1939, but the present publication reports that the metal has not been isolated. Similarly, Sidgwick in the publication on Chemical Elements states that "practically all the rare earth elements have by now been got in the metallic state", while the present publication reports that many of the lanthanide metals have not been isolated. The discovery of hydrogen is much earlier than 1766, and Cavendish himself remarks about others who had prepared the gas before him.

S. V. A.

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**Structure Reports.** Vol. 10 for 1945-46. Gen. Ed. A. J. C. Wilson. (Published for the International Union of Crystallography by N. V. A. Oosthoek's Uijgerers Mij, Utrecht), 1953. Price D. Fl. 45.

Structure Reports require no introduction to the crystallographer, containing as it does a critical review of the structural data available in papers from widely different sources during the year concerned. These data are given so completely that "no further structural information would be gained by consulting the paper itself". The present volume follows the arrangement in the volumes published earlier. It is divided into three sections—I, Metals; II, Inorganic Compounds; and III, Organic Com-

pounds. Each report contains information usually arranged in the following order : name, formula, papers reported, unit cell, space group, atomic positions and parameters, interatomic and intermolecular distances, material, discussion, details of analysis and references.

Since this is the first time that this series is being reviewed in *Current Science*, it may be mentioned that structure reports are intended to be a continuation of Strukturbericht, which stopped publication during the last war. The reports for 1947-48, Vols. 11 and 12 have already appeared, and the gap is now being filled. Material, not of direct interest from the structural standpoint, is generally omitted or only briefly indicated, except in the case of those occurring in Russian or other inaccessible journals, in which case they are presented in greater detail. This is indeed a commendable arrangement. The reviewer feels that the inclusion of the address of the authors after each reference (in a shortened form, as for instance in American Chemical Abstracts) would be helpful to readers in getting reprints, if the journal concerned is not available.

The printing and get-up leave nothing to be desired. Compilations of this type are of inestimable value to the research worker and the International Union of Crystallography is to be warmly congratulated for having undertaken the task and carried it through.

                    G. N. RAMACHANDRAN.

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**The Geology of Ireland.** By G. K. Charlesworth. (Oliver & Boyd, Edinburgh), 1953. Pp. 276. Price 25 *sh.*

The author has traced the geology of Ireland, from the pre-Cambrian to the recent, through eight chapters. In an introduction he defines the scope of geology and explains various geological terms like alluvium, bedding, pitch, faults, etc. Ireland has had a troubled geological history as evidenced by several unconformities, and repeated phases of igneous activity. Several formations are unrepresented in Ireland like the pliocene, miocene, oligocene, oolites and the Devonian.

In his account of the pre-Cambrian, the author draws constant parallels to the rocks of Scotland—the Lewisian gneisses, the Torridonian sandstone, the Moine schists and gneisses, and the Dalradian ; and notes the absence of the Torridonian in Ireland. He observes, "The Irish Dalradians, on account of their widest extent, variety and persistence, and scientific features, constitute one of the most

important series of rocks in the country". The palaeozoic rocks, their fauna and flora, are described with great vividness. The origin of rocks and their economic importance, the genetic relationship of fossils, their environmental conditions and the resultant palæogeography, are clearly stated. The Ordovician igneous manifestation reached its climax in south-east Ireland, while the silurian igneous activity, which was quiescent in Britain, was feebly and sporadically active in Ireland as in Wales.

Want of space prevents an analysis and a summary of other chapters, but they are delightfully written in a fascinating language. This is a book not only on the geology of Ireland, but also on the various principles of geology, and their application to the fields of petrology, palæontology and stratigraphy, though illustrated in regard to the geological formations of Ireland.

                                        P. R. J.

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**Geological Maps.** By G. W. Chiplonkar. (Dastane Brothers' Home Service, Ltd., Poona), 1952. Pp. 92. Price Rs. 7-8-0.

The volume represents a useful summary of lectures delivered by the author to students of the B.Sc. standard in geology in the Banaras Hindu University. The inclusion of references to standard works such as those by Levin, Billings, Chalmers and others would perhaps have enhanced the value of the work.

In the matter of interpretation of geological maps, the author has chosen for a first illustration maps 88 and 89 from Indian Coal strata, which are rather complicated, as compared with illustrations in other text-books. The drawings are badly printed, and they spread out. The printed lines themselves sometimes illustrate faults and folds, *e.g.*, p. 67. But for these defects, which are obviously faults of printing, the book is a good text-book for students of Indian Universities, who go up for the B.Sc. Degree.

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**Tables for the Use of Geologists, Prospectors and Mining Engineers.** Revised Second Edition. By N. L. Sharma. (Indian Society of Engineers, Calcutta), 1953. Pp. ii + 30. Price Rs. 5.

The author has compiled these tables, not to help the readers in identifying mechanically any particular specimen by the method of elimination, but rather to give them comparative and collective information about mineral and rocks, as well as to show the economic importance of minerals and their distribution in

India. Prof. H. H. Read, in his foreward, says, "The Tables, I am sure, will be of value to the public, to whom they are addressed".

The public will surely find the information in Table 18 useful, because it gives the occurrence of economic minerals in India, and with the help of Table 20, it may be possible for them to make a preliminary identification of minerals. Tables 1 and 11, on crystal systems, and the optical characters of minerals may not have any appeal to the layman. The book, as a whole, gives information on crystals, minerals, rocks and ores, in the form of short notes, useful to students whose major study is not geology, such as engineers and technologists, who have to brave a year of geology before they take up their professional degrees.

<div align="right">P. R. J.</div>

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**Minerals for the Chemical and Allied Industries.** (Chapman & Hall), 1954. Pp. 692. Price 75 *sh.*

The industrial civilization of today makes increasing demand on a wide variety of minerals. Minerals and metals which a few years ago were hardly more than scientific curiosities are now finding employment in chemical, metallurgical and allied industries, in the production of refractories, ceramics, glasses, paints, alloys, electronic appliances and numerous other specialized goods of use in modern technologies.

The book under review is not a treatise on mineralogy for the use of college and university students, but is a compendium of intelligence on the present-day industry, marketing and utilization of minerals and metals, and presents matter-of-fact information on the production, source of supply, processing and extraction of useful products from them. About 80 raw products of mines are dealt with in this manner ; these include non-metallic minerals, ores, metals, salts, clays, sands, rare earths and native elements, the main objective being to provide factual and standard data of value to producers and consumers of the products dealt with. Each mineral, after its definition, is considered under the headings of extraction, world production, ore dressing and beneficiation uses and appliances, followed by a select bibliography for readers who want further information. At places standard specifications of the British Standards Institution and the U.S. National Stockpile are also appended. 174 useful tables giving chemical composition, trade and standard specifications, figures for produc-

tion and consumption are included, and the possibilities of substitute minerals and compounds doing duty for scarce minerals and metals are indicated.

The work should prove of use to producers, manufacturers and consumers of mineral raw and fabricated materials, who will find in its pages carefully sifted information presenting recent developments in meeting consumer demands, commercial statistics and up-to-date techniques. There is a good index. With the steady growth of mineral and metal industries in India the book should prove of interest to Indian manufacturers as providing the right type of technical and statistical intelligence.

The price of the book, 75 shillings, considering that there are no illustrations, charts or maps, may be regarded as high but one soon realizes that the collecting of data and constants of the description given above, with which the pages of the books are filled, must have implied much labour and cost.

<div align="right">D. N. WADIA.</div>

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**Table of Secants and Cosecants to Nine Significant Figures at Hundredths of a Degree.** (NBS Applied Mathematics Series 40.) (Order from Government Printing Office, Washington 25, D.C.) Pp. 46. Price 35 cents.

The recent demand for many-figure tables of the trigonometric functions with the argument in decimal division of a degree has prompted this publication. It is a useful companion to the previously published tables of sines and cosines to 15 decimal places at hundredths of a degree (Applied Mathematics Series 5). The entries are considered correct to within six-tenths of a unit in the last place given.

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**Progress in the Chemistry of Fats and Other Lipids, Vol. 2.** Edited by R. T. Holman, W. O. Landberg and T. Malkin. (Pergamon Press, London), 1954. Pp. 348. Price 63 *sh.*

In recent years a great need has been felt by scientific investigators for the periodic publication of authoritative digests of recent advances in several fields of biochemistry, particularly in the more rapidly progressing areas of scientific research, such as chemistry of fats and other lipids. Volume I of the present series has already appeared.

The volume under review is the second of the series, and consists of the following seven well-written articles on different topics : (*i*) the polymorphism of glycerides, (*ii*) autoxidation of fats and related substances, (*iii*) nutritional

significance of the fats, (*iv*) the surface properties of fatty acids and allied substances, (*v*) urea inclusion compounds of fatty acids, (*vi*) infra-red absorption spectroscopy in fats and oils, and (*vii*) counter-current fractionation of lipids. The article by H. J. Duel Jr. on the nutritional significance of the fats is perhaps the most thorough, exhaustive and up-to-date treatment dealing in an excellent manner with every aspect of the subject. Mention may also be made of the chapter on infra-red absorption spectroscopy and another on counter-current fractionation of lipids, two very useful techniques, which have recently come to be widely used in the study of fats and oils. The inclusion of such a variety of topics is particularly helpful since the interests of the lipid specialists often extend to areas that may be quite unrelated to their own. In fact, the volumes in this series are intended to come out yearly, and to include chapters on all types of research in fats, whether biological, chemical or industrial. After reading the first two volumes, there is no doubt that biochemists will eagerly look forward to the future publications in this series.

P. S. SARMA.

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**The Biochemistry of Genetics.** By J. B. S. Haldane. (George Allen and Unwin, London), 1954. Pp. 144. Price 15 *sh.* net.

This new book by Professor Haldane is the first of its type to be published on the subject of the biochemistry of genetics. As the author himself remarks, 'it is emphatically not a text-book'; nevertheless, it admirably summarises the basic and more important of the facts dealing with the elements of genetics as well as the biochemical genetics of moulds, yeasts, bacteria, viruses, higher plants, higher animals and man, and as such should help to fill the gap in the text-book-shelf of the teacher and student of biochemistry. In fact, by choosing suitable examples from a mass of published work and placing them in clear and simple language, the author has succeeded remarkably in providing a much-needed bridge between the 'pure geneticist' and the 'pure biochemist' and shown to them how inseparable the two aspects are in presenting a true picture of the living cell. What is even more remarkable about this book is the rational and the balanced development of the subject characterised by the judicious selection of references rather than mere chronological treatment.

The reviewer unhesitatingly recommends this volume to both the biologist and the biochemist. J. V. B.

## Books Received

*Metabolic Integrations.* By P. G. Watson. (W. Heffer & Sons., Cambridge), 1954. Pp. 12. Price 4 *sh.*

*A Historical Survey of Petrology.* By F. Y. Loewinson-Lessing. Translated by S. I. Tomkeieff. (Macmillan & Co.), 1954. Pp. x + 112. Price 12 *sh.* 6 *d.*

*Optical Image Evaluation.* (NBS Circular 526), 1954. Pp. 289. Price $ 2.25.

*A Treatise on Applied Hydraulics.* Fourth Edition. Revised and Enlarged. By H. Addison. (Chapman & Hall), 1954. Pp. vii + 724. Price 56 *sh.*

*The Optical Properties of Organic Compounds.* Second Edition. By A. N. Winchell. (Academic Press Inc.), 1954. Pp. xviii + 487. Price $ 12.00.

*Report of the Rothamsted Experimental Station for* 1953. Pp. 227. Price 7 *sh.* 6 *d.*

*History of Indian Pharmacy.* Vol. I. Second Edition. By G. P. Srivastava. (Pindars Ltd., Calcutta-20), 1954. Pp. xiv + 276. Price Rs. 12-8-0.

*Biological Applications of Freezing and Drying.* Edited by R. J. C. Harris. (Academic Press Inc.), 1954. Pp. xii + 415. Price $ 10.00.

*Elements and Atoms in Greek and Indian Thought.* By N. S. Subramanya Sastry. (Copies from the Bangalore Press, Mysore), 1954. Pp. 74. Price Rs. 3-8-0.

*Survey of Research Problems in Plastics with Special Reference to the Development of Plastics Industry in India.* (Council of Scientific and Industrial Research, New Delhi), 1954. Pp. 155. Price Rs. 5.

*Nutritional Factors and Liver Diseases,* Vol. 57. Art. 6. By K. Schwarz and 58 other scientists. (Annals of the New York Academy of Sciences). Pp. 615-962. Price $ 4.50.

*The Standing Wave or Hydraulic Jump.* Second Edition. Revised and Enlarged. (Publication No. 7 of the Central Board of Irrigation and Power.) (The Manager, Govt. of India Press, Simla), 1950. Pp. x + 146. Price not given.

*Bibliography of Soil Science and Fertilizers with Reference to India.* Bulletin No. 74. Compiled by K. K. Guha Roy. (The Indian Council of Agricultural Research), 1954. Pp. iv + 131. Price not given.

*Monomolecular Layers.* Edited by H. Sobotka. (American Association for the Advancement of Science, Washington D.C.), 1954. Pp. vii + 207. Price not given.

# SCIENCE NOTES AND NEWS

## Occurrence of *Oidiopsis taurica* (Lev.) Salmon on a New Host *Ricinus communis* L.

Sri. P. P. Chiddarwar, M.A.C.S. Laboratories, Poona-4, writes as follows :

Since publishing a note on the above subject (*Curr. Sci.*, 1954, 23, 198), the author finds that the occurrence of this fungus on *Ricinus communis* L. has been recorded previously by Ramakrishnan and Narasimhalu (*Curr. Sri.*, 1941, 10, 211). The author's record is therefore not a new one, but only a new record of the host in the Bombay State.

## World Calendar

Prof. M. N. Saha, Chairman, Calendar Reform Committee, explained the basic idea of the proposed World Calendar at a meeting of the committee for non-governmental organizations of the U.N. Economic and Social Council held in Geneva on July 7, 1954.

Under the plan, each year would be divided into four equal quarters, each of which would have 91 days. The first month of each quarter—January, April, July and October—would have 31 days each. This would give a year of 364 days and the final day of each year, December 31, would have no week day denomination, but be known as World Day. In a leap year a similar day would be inserted after June 30 to be known as Leap Year Day.

If the World Calendar was started in 1961 on a Sunday, the last day of the year would be World Day. Thus, 1962 would start on a Sunday and so would every year until 1965, but 1964, the next leap year, would have an additional day, Leap Year Day inserted after the last day of June in addition to the usual World Day. Thus, the ensuing year 1965, would also start on a Sunday. Each quarter would begin on a Sunday. The second months of each quarter—February, May, August and November—would begin on a Wednesday and the other months—March, June and December would begin on a Friday. It is clear that the World Calendar violates no scientific principles nor would it interfere with religious calendars.

## New Sky Atlas

The Palomar Observatory in California, United States, will soon publish the first volume of a five-volume sky atlas resulting from a six-year survey of the heavens. The atlas will contain 1,758 photographs, each 14" square, the area covered by each print being about as large as the bowl of the *Big Dipper* (the ploughshare of the *Plough*). American astronomers have been able to map about three-quarters of the entire sky, all that is visible from Mount Palomar, to a distance of 500 million light years. It is expected that about 100 copies will be issued for the use of observatories, universities and scientific institutions.—UNESCO.

## *New Directory of International Scientific Organizations*

A second and revised edition of the 'Directory of International Scientific Organizations' has been issued by UNESCO. It contains entries on 264 organizations as against 202 in the first edition. These are grouped in three main chapters : Basic Sciences, Applied Sciences and Miscellaneous.

For each organization listed, the following information is given : official name, address, nature and aims as well as a short history ; governing bodies and officers, members and commissions; facilities, such as laboratories, libraries, etc.; financial resources; frequency of meetings; voting procedures; relations with other international organizations; publications; bibliographical details of publications containing references to the organization and supplementary information likely to interest readers. Price $ 2.50.

## *Interlingual, Scientific and Technical Dictionaries*

A "Bibliography of Interlingual, Scientific and Technical Dictionaries" (Revised and enlarged edition) has been published by UNESCO. It contains a list of 1629 dictionaries and glossaries which give the equivalents in two or more languages of technical terms relating to any of the 237 different branches of the natural sciences and their applications in engineering, technology, medicine and agriculture. The dictionaries referred to in this bibliography are specialized works of practical use to translators, librarians and other concerned, and are designed to facilitate the task of those engaged in technical translations. Price $ 1.75. (On sale at National Distributors of UNESCO publications.)

## Bhagirath

A monthly journal bearing the above title has been inaugurated by the Ministry of Power and Irrigation, Government of India, with a view to keep the public informed about the progress of the irrigation and power projects in the country. The inaugural number contains authoritative articles on the Bakra-Nangal Project, Trisuli Power Project, Power Development in the Punjab and such like. The journal is bound to be of service to the large section of the public for whom it is intended. Copies can be had from the Director, Publications Division, Old Secretariat, Delhi.

## Prof. K. S. Krishnan

Prof. K. S. Krishnan, Director, NPL, Delhi, has been elected Vice-President of the International Union of Pure and Applied Physics for a second term, at the recent meeting of the International Union held in London.

## Identification of the Common Cold Virus

Electron microscope studies by a team of scientists from the Walter Reed Army Hospital in Washington, and the University of Maryland have revealed that the common cold virus looks like a billiard ball about three-millionths of an inch thick. The studies also indicate that it resembles the viruses of influenza and measles.

## Fresh Light on Nuclear Decay

The discovery of a new fundamental particle or a new mode of decay of known particle, was observed by Dr. G. Shrikantia, working under Drs. E. P. George and A. J. Herz in the Sydney University, in one of 100 special photographic plates which had been exposed to cosmic radiation 14 miles above the earth.

The "event" recorded in the plate appeared to be the stopping of one nuclear particle and from the points where it stopped there emerged five particles, at least three (probably four) of which are likely to be electrons. Such an event is believed to be unique.

The particular interest in the discovery derives from the fact that five particles have emerged from the point of decay of *one* nuclear particle, at least three or four of which are likely to be electrons. There is no case on record in which so many charged particles have appeared to diverge from the same point. According to Prof. H. Messel, Department of Physics, Sydney University, the discovery is likely to throw fresh light on the problem of nuclear decay.

## The Royal Institute of Chemistry

An Examination for the Associateship of the Royal Institute of Chemistry will be held in Delhi in the latter half of January 1955. Forms of application for permission to enter may be obtained from the Registrar, Royal Institute of Chemistry, 30, Russell Square, London W.C. 1, or from the Hon. Secretary of any of the Local Sections of the Institute in India, and must be returned direct to the Institute in London so as to arrive not later than 30th October 1954.

*Hon. Secretaries of the Local Sections in India*: R. Rajagopalan, Indian Institute of Science, Bangalore-3; K. V. Sundaram Ayyar, 3, Jagadiswara Street, T'Nagar, Madras-17; A. M. Tyabji, Somerset Cottage, 61-D, Bhulabhai Desai Road, Bombay-26; G. S. Saharia, Department of Chemistry, The University, Delhi-8; K. B. Sen, C/o. Bird & Co., Ltd., Coal Department, Calcutta.

## THPC for Fireproofing

A new organo-phosphorus compound developed at the U.S. Southern Regional Research Laboratory is reported to be far superior to any previously known anti-flame substance. This is tetrakis (hydroxymethyl) phosphonium chloride $(HOCH_2)_4$ $PCl$, *THPC*. It is produced by a reaction between phosphine, formaldehyde and hydrochloric acid, and one American company has begun manufacturing it on pilot-scale for experimental supplies. Unlike some of the anti-flame chemicals now used for treating cotton, *THPC* is not water-soluble and is therefore not lost in laundering; tests of *THPC*-treated cotton fabrics after as many as 15 launderings have shown that the standard flame test can still be passed. Another advantage claimed for *THPC* is that it does not reduce the tearing or breaking strength of cotton fabrics at all appreciably; and it appears to give improved crease-resistance.

## CORRECTION

*Vol. 23, No. 6, p. 186*: Note on "Catalysed Polymerisation of Styrene in Toluene", Equation (2) should read as follows:

$$\frac{1}{P} = \frac{(k_i k_t)^{1/2}}{k_p} \cdot \frac{B^{1/2}}{M} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M}$$

*Vol. 23, No. 6, p. 201*: Review on "Analysis of Deformation" in Column 1, line 33, *read* 2 $\epsilon_i$ *for* $\epsilon_{ij}$

# Current Science

## THE INTERNATIONAL GEOPHYSICAL YEAR 1957–58

METEOROLOGISTS, geophysicists and scientists in allied fields discovered long ago that their sciences have to be reckoned and dealt with as truly 'international', for, the physical processes at work transcend the limits of 'nationalism'. It is therefore a matter for gratification that for the third time in a century, scientists from various disciplines and drawn from different countries, are to join, during 1957-58, in a critical examination of the ever-changing aspects of man's immediate physical environment. Such concerted endeavour on a limited scale, confined to Polar phenomena, had been arranged during the years 1882-83 and fifty years later, in 1932-33. But the forthcoming "International Geophysical Year" (IGY) is to witness a global endeavour of the leading scientists of the world to probe into the mysteries of our planet and its atmosphere, and obtain as comprehensive and complete a picture of the various physical processes at work as possible.

It may be of interest to mention here that the IGY has been engaging the attention for sometime past of various international scientific bodies such as the International Union of Scientific Radio, International Astronomical Union, International Union of Geodesy and Geophysics, International Geographical Union, World Meteorological Organisation, International Union of Pure and Applied Physics, etc.

The Bureau of the International Council of Scientific Unions (ICSU) has formed a Special Committee representing the various International Unions concerned which has been called the CSAGI (Comité Special de l'Année Geophysique Internationale) which met in Brussels during June 30-July 3, 1953, and elected Prof. Sydney Chapman as its President, Dr. L. V. Berkner as Vice-President and M. Nicolet as General Secretary. The CSAGI discussed the proposals for the various National Committees constituted for the IGY by differ-

ent countries and outlined the scope of the programme. These problems will again be reviewed in the light of the detailed proposals and programmes asked for from different co-operating countries and finalised when the Committee meets again in October 1954 immediately after the Tenth General Assembly of the UGGI which is being held there from the 14th to the 25th September 1954. It is expected that the CSAGI will be in a position to publish and distribute a volume outlining the world programme for the IGY-1957-58, early in 1955, giving the participating nations sufficient time to prepare themselves for executing their respective parts of the international programme.

The programme already outlined by CSAGI covers (*i*) Meteorology, (*ii*) Latitude and longitude determinations, (*iii*) Geo-magnetism, (*iv*) the Ionosphere, (*v*) Aurora and air-glow, (*vi*) Solar activity, (*vii*) Cosmic rays, (*viii*) Glaciology, and (*ix*) Oceanography. Large-scale observations embracing the above topics are to be recorded on three specified "World Days" each month, one near full moon and two near new moon and, in addition, on about two other special "World Days" each month to be declared about 3 weeks in advance, to coincide with predicted geophysical disturbances, solar eclipses, solar flares, and unusual meteor showers, etc.

In meteorology the main world problem to be investigated is that of the general circulation and the associated thermodynamics, particularly in the upper atmosphere, above the troposphere. Special attention is to be paid to the collection of complete information up to 30 km. height along the three meridians 10° E., 140° E. and 70° W. from pole to pole so as to elucidate the mass transfer of the atmosphere in the east-west direction. A dynamical study of the equatorial atmosphere is also expected to lead to an understanding of the mass transfer between the two hemispheres in relation to the general circulation.

The programme under geomagnetism includes the study of the changing morphology of magnetic storms and activity in relation to variations in auroral activity and associated changes in the electric currents in the upper air. The diurnal variation of the three magnetic elements in the zone containing the magnetic and geographic equator is also to be investigated. Rocket observations extending to high altitudes are expected to reveal the connections between geomagnetic changes and the electric currents associated with the aurora.

In the programme of auroral observations, air pilots and meteorologists are also to take part. It is also proposed to conduct synoptic observations on the air-glow at selected centres.

The latitude and longitude programme aims at improving the accuracy of time determination and to extend the knowledge of the irregularities in the earth's rotation, of relative displacements on the earth's surface and of time of propagation of radio waves.

The programme under solar activity includes observations of chromospheric flares and the continuous recording of wave frequencies emitted from the chromosphere and the corona. Rocket measurements of solar ultra-violet emission spectra and of the photochemical equilibrium of the ozone layer and above in our atmosphere are also planned. Limited programmes under glaciology and oceanography and scientific exploration of the Antartic regions are also within the scope of the IGY.

The National Committee of India for the IGY under the Chairmanship of Dr. K. S. Krishnan, Director of the National Physical Laboratory, with representatives of the Meteorological Department, the Survey of India and other interested scientific institutions has drawn up a programme to be carried out in India in consonance with the ultimate World Programme of the CSAGI. India proposes to include an additional meridional cross-section in the northern hemisphere at 75° E. for the intensified study of the upper air over Asia, with half-a-dozen stations in India in the north to south direction taking part in the programme for studying upper winds, temperature and the ozone layer. Stations along the latitudes 23° N. and 15° N. for recording upper winds and temperatures on the World Days are also proposed. Radar observations on cloud development, measurement of the electric potential gradient and conductivity of the upper air, the radiation and thermal balance and the moisture balance at the earth's surface, besides rain measurements by selected ships at sea are also included under Meteorology for the IGY.

For the study of geomagnetic and associated phenomena in the upper air, it is proposed to have continuous records and absolute measurements at Alibag, Kodaikanal and Dehra Dun. There will be two additional stations north and south of Kodaikanal in South India to study the variations along the magnetic equator. The co-operation of the Physical Research Laboratory at Ahmedabad has been secured for recording the spectrum of the air-glow. Seven stations in India will record ionospheric data

both day and night. Intensified observations on the sun at Kodaikanal, cosmic ray time-variation studies at the Cosmic Ray Laboratories in India, latitude and longitude determinations, exploration of the Himalayan glaciers and Indian seas will all engage the attention of our scientists during the IGY.

It is hoped that the Government of India will give every encouragement to scientists in India to play an adequate part in this great international endeavour, and that the Indian Universities and National Laboratories too will extend every co-operation to the National Committee in organising and executing this laudable programme.

## A SIMPLE DEVICE FOR PARAFFIN EMBEDDING

PARAFFIN embedding under an electric bulb is preferred by many workers. It is not only easy to operate, but is inexpensive and can be installed anywhere near an electric point. It is found to be more accurate and easier to control than the common thermostatic ovens.

After working at it for nearly nine years I have been able to introduce certain modifications and features making it safer and easier to operate. About a pound of paraffin wax is 'smoked' in a 9″ long beaker of about 2·5-3″ diameter. The wax should fill up three-fourth of the container. An electric bulb of not more than 60 watt is suspended above the surface of the wax. A stronger bulb is liable to melt the whole mass of the wax, which is undesirable. It is best to have a 40 watt lamp just touching the surface of the wax. A small watchglass is kept on a piece of wire-mesh which is suspended by means of thin copper wires and adjusted about 1″ below the surface of the melted wax, and about ½″ above the solid surface. The distance may be adjusted by a little experience and is different in rooms of different temperatures. The material for embedding is put on the watchglass. As it is kept near the surface of the solid wax and in the molten medium, it remains near the melting point, an essential requisite for proper embedding. Temperature in this region does not rise as the latent heat of melting of wax does not allow it to go high and because the amount of wax is quite big and the source of heat is above the surface and small as well as steady, the whole of the wax never melts. Thus the material may be left in the bath without any danger of getting 'cooked' or 'roasted'.

The wax container is placed in a small wooden box, whose inner lower half is painted black and the upper white. The bulb is suspended from the top of the box and a thermometer is introduced through a hole to record the temperature near the material. Another wooden box containing a bulb of 100-50 watt is used for keeping crucibles and wax-pans, etc., so that at the time of making blocks a ready supply of melted wax may be assured. The whole apparatus with the thermometer and the bulbs costs about Rs. 7 to 8. The working cost is very low and it does not require to be sent for repairs to any workshop. Another advantage is that for different types of wax with varying melting points, separate baths can be maintained.

Birla College of Science,    H. L. Sharma.
Pilani.

## USE OF ANTI-MALARIALS

THE recommendations on the use of anti-malarial drugs prepared by the Malaria Sub-Committee of the Colonial Medical Research Committee have been published in a recent issue of the *British Medical Journal* (July 17, 1954).

The Committee observes that no single drug at present available is effective against all phases of the cycle of development of the malaria parasite ; the preparation to be used for a particular purpose will be that active against the appropriate phase. The purposes for which anti-malarial drugs are used are :

(1) For causal prophylaxis or suppression (destruction of the parasite in the pre-erythrocytic phase or in the asexual erythrocytic phase). (2) For treatment of the overt malarial attack (destruction of the asexual parasites in the blood stream). (3) For radical cure of vivax and quartan malaria (destruction of the late exo-erythrocytic forms). (4) For prevention of transmission (destruction of the gametocytes in the peripheral circulation or interruption of sporogony in the mosquito). Details of the specific drugs to be used and the dosage are given in the article given above.

# ON LINEAR STRUCTURES IN THE DIORITES AND ASSOCIATED ROCKS IN EASTERN SINGHBHUM, BIHAR

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IN the course of detailed petrogenetic studies between Kudada (22° 42′ : 86° 12′) and Chandanpur (22° 33′ : 86° 19′) in Eastern Singhbhum, five distinct types of lineation were observed and mapped for the first time in the diorites and the associated granitic and metamorphic rocks of the area.

The area, which was geologically mapped by Dunn and Dey,[1] is covered largely by the 'Singhbhum Granites' (chiefly leuco-granites, with granodioritic and dioritic patches) and a series of metamorphic rocks belonging to the Iron-ore series. The latter consist chiefly of phyllites, secondary quartzites and epidiorites and are older than the granitic rocks. All these rocks are cut across by the 'Newer dolerite' dykes.



FIG. 1. Puckering lineation in secondary quartzite at Binburu (22°40′ : 86°13′).

The present author finds that excepting the Newer dolerites, all the rock-types in this area show a striking structural unity, as regards foliation, lineation and joints. Even where the junction between the granites and the diorites on the one hand, and the metamorphites on the other, cut across the regional strike, the foliation as well as lineation and joints have essentially the same disposition in the different rock-types. Foliation, lineation and joints in the granites, diorites, etc., are thus all of secondary origin.

Two types of foliation planes are present in these rocks: (i) a well-developed, steeply-dipping mineral-foliation ($S_1$), caused by a parallel arrangement of minerals, chiefly hornblende, quartz or mica; (ii) a set of close-spaced joint planes ($S_2$), along which shearing accompanied by sericitisation, chloritisation or tremolitisation has taken place. In places, $S_1$ and $S_2$ make angles of 10-50° between them. As indicated by the bending of parallelly arranged hornblende crystals close to the major shear-planes and minor displacement of mineral-foliation along some of the shear planes, $S_2$ must have originated at a later date than the mineral-foliation.

Linear structures are found both on the planes of mineral-foliation ($S_1$) and shear-foliation ($S_2$) and are of the following types:

*Type 1. Mineral-lineation on $S_1$, sub-parallel to its dip.* This is due to a linear arrangement of hornblende and/or quartz along the plane of mineral-foliation and is best seen in the hornblende-bearing rocks. Sub-ellipsoidal fragments of epidiorite (about ¾″ × ½″ × 1/6″) with a linear arrangement sub-parallel to dip were noticed in an exposure of epidiorite-tuff near Gobradih (22° 35′ : 86° 16′).

*Type 2. Puckers on $S_1$, sub-parallel to dip.* These consist of small-scale folds (generally symmetrical) with crests spaced a few mm. apart, and are best seen in the secondary quartzites and the phyllites (Fig. 1). This type of lineation often accompanies lineation of Type 1. Usually the two are parallel to each other, but in places a small angle of 5-18° is noticed. Large-scale warps on $S_1$ with axes parallel to those of the small-scale folds have caused local sharp variations of the foliation-strike from NNW-SSE to north-east, south-west or even east-west.

*Type 3. Mineral-lineation on $S_1$, sub-parallel to strike.* This is similar to Type 1, but is seen only locally, such as near Matku (22° 41′ : 86° 13′ 30″), south of Marchagora (22° 41′ : 86° 13′) and west of Edalghutu (22° 38′ 30″ : 86° 16′).

*Type 4. Puckers on $S_1$, sub-parallel to strike.* They are similar to the puckers of Type 2, but are much more rare. Puckers of this type are not prominent and tend to be asymmetric. Co-existence of the two systems of puckers at approximately right angles to each other has given rise to 'ridge and basin' type of structures on the plane of foliation. The two sets of puckers intersect at 72-84° on the plane of foliation.

*Type 5. Mineral-lineation on* $S_2$, *sub-parallel to dip.* 'Streaks' of fine sericite or tremolite stringing out in lines on the shear-planes have given rise to a lineation on $S_2$. Sometimes these are accompanied by striations resembling slickensides.

In addition to the above five types, intersection of $S_1$ and $S_2$ has locally given rise to a linear structure on $S_1$; some of the joint-planes show slickensiding; intersection of diagonal joints in sheared epidiorites near Dabanki (22° 38′ : 86° 16′) has given rise to spectacular rodding.

forms interrupted lines; b-lineation in the present area is therefore believed to have developed slightly earlier than the a-lineation. The fact that the angle between a-lineation and b-lineation varies between 72° and 84° and is never exactly 90°, may have been due to a slight change in the direction of shear during the interval between the formation of b-lineation and that of a-lineation. The 'striation' type of lineation on $S_2$ is obviously a-lineation, with respect to movement along $S_2$. The sequence of formation of the different types of lineation appear to be as follows:

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─────────────────────────────────────────────────────── → Time

Type 3─────── ────── ──────────────── ──── ────────

    Type 4───────── ──────────────────── ──── ───────

        Type 1────── ─────── ──────────── ──── ───────

                                          Formation of S₂

        Type 2────────── ─────────────── ───────

            Type 5────────── ──────── ──────
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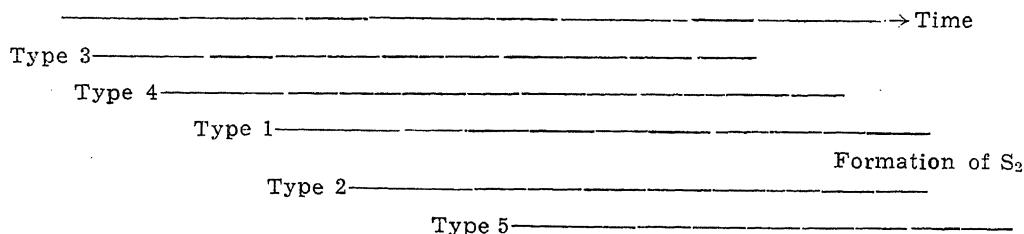
Since the regional fold-axes trend NNW-SSE, while lineations of Types 1 and 2 show steep plunge either to the south-west or north-east, the author regards these two types of lineation as a-lineation, as defined by the movement pattern along $S_1$. Because of their gentle plunges either to the NNW or SSE, lineations of Types 3 and 4 are to be regarded as b-lineation. Wherever the puckers of Types 2 and 4 intersect, the former occur in prominent continuous lines, while the latter type

A fuller account of these structures, including their petrogenetic implications, will be published elsewhere.

The author is grateful to Dr. S. N. Sen of Geology Department, Calcutta University, for his kind interest and helpful guidance during the progress of this work.

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1. Dunn, J. A. and Dey, A. K., *Memoirs Geol. Surv. Ind.*, 1942, **69**, Pt. 2.

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## LADY TATA MEMORIAL TRUST

THE Third Report on the working of the Lady Tata Memorial Trust, India Section, has been published, covering the years 1947-52. The Advisory Committee notes that compared to the preceding six-year period, there has been a steady increase in the number of applicants for the scholarships, the average being 27 and 39 per year respectively for the two periods, and that the academic qualifications of the applicants remain at a fairly high standard. There was also a much wider range of subjects offered for study. These included diseases of the blood, liver damage, diabetes, leprosy, tuberculosis, filariasis, carcinoma, arthritis; metabolic and nutritional studies with proteins, fats, minerals and several of the vitamins, synthesis of new anti-malarials, anti-

bacterials and other chemotherapeuticals, and studies on natural products of therapeutic importance.

During the period under review, 29 scholarships were awarded, the number of students being 19. Nine scholars held the scholarships for 2 years and nine for 1 year. Extension for a third year was granted to one scholar.

On the whole, commendable progress was made by the scholars in their programmes of research and one result of the Lady Tata Memorial Awards has been the creation of a body of research workers in chemotherapy, pathology, clinical medicine and related subjects, some of whom at least will be a valuable permanent addition to the staff of Indian Universities and research institutions.

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# MECHANISM OF ENZYME ACTION*

THIS symposium on the mechanism of enzyme action is a logical extension of the previous symposia on phosphorus and copper metabolism held under the sponsorship of the McCollum-Pratt Institute of the Johns Hopkins University. The availability of isotopes and a number of purified enzymes has helped in elucidating the mechanism of a large number of enzyme catalysed reactions. The relation of protein configuration to its catalytic activity, the function of metal ions in forming chelates with substrate and enzyme, and recent developments in the understanding of the mechanism of hydrogen and electron transport and of group transfers have been brought together in a well-knit and comprehensive manner by more than one hundred scientists who participated in this symposium.

The first section on protein configuration and biological activity opens with a discussion by Kirkwood, on the forces operating between interacting protein molecules, with particular reference to those involved in the interaction of enzyme with protein substrate, or of antigen and antibody. The essential groups of chymotrypsin and the availability of these during the formation of the active enzyme from its zymogen are discussed by Herriot and by Neurath and co-workers, while the nature of the bonds involved in the maintenance of the native protein in the folded state and the mechanism of action of the various denaturing agents are considered at length by Kauzmann.

In the second section on the kinetics of enzyme action, Eyring discusses the relation between reaction rate and activation energy of enzyme-substrate complex. The role of enzyme-substrate complex as an intermediate in enzyme catalyzed reactions is further developed by Bull, with particular emphasis on the kinetic treatment of reactions involving activators and inhibitors. Fredenwald and Maengwyn-Davies have dealt with the simplification of the Michaelis-Menten theory, with a view to apply it to enzyme-catalysed reactions in general.

In the third section, the function of metal ions in enzyme catalysis and the relation of chelation to catalysis are discussed by Calvin. The nature of the group in protein molecule responsible for the binding of the metal ion and the property of the metal protein complexes are discussed by Klotz. Further, the role of metal ion in forming co-ordination complexes with substrate and enzyme is illustrated by Smith and co-workers on the basis of their studies on two highly purified metal peptidases.

In the fourth section on the mechanism of electron and hydrogen transport is included an article by Britton Chance on the nature of the enzyme mechanism in living cells. The delicate spectrophotometric method of Chance has permitted the direct observation of reactions involving peroxidase, cytochromes and pyridine nucleotide enzymes in intact cells. Evidence for the direct transfer of hydrogen in reactions catalyzed by pyridine nucleotide dehydrogenases and for the steric specificity of such reactions is presented by Vennesland.

The final section contains papers on the function of enzymes in group transfer reactions. Racker has reviewed the formation of carbonyl and acyl complexes, discussing at length, the role of SH groups in acyl transfer. Uptodate information on the role of lipoic acid in the oxidative decarboxylation of keto acids is presented by Gunsalus. Further, the role of adenosine triphosphate in pantothenic acid synthesis and the applicability of the mechanism for polypeptide synthesis is discussed by Lipmann, and the mechanism of transglycosidation is discussed by Kalckar with reference to the role of the uridine containing co-enzymes in the formation of polysaccharides and nucleotides.

A lucid summary of the proceedings is given in the end by Bentley Glass. The book contains a number of important original contributions, and the incorporation of the discussions should be considered as a valuable feature. The participation of so many eminent enzymologists in this symposium lends a distinctive feature to this volume, and makes it quite an authoritative summary of the mechanism of enzyme action as it is understood today.

P. S. SARMA.

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# OBITUARY

## SIR LEWIS LEIGH FERMOR

WITH the passing away of Sir Lewis Leigh Fermor, Kt., O.B.E., D.Sc., A.R.S.M., F.R.S., F.G.S., M.I.M.M., F.N.I., F.A.S.B., one of the most illustrious geologists who have worked in this country and whose death took place on the 26th May, 1954, at his new home at Woking, Surrey, England, Indian geology has lost one of its best exponents and architects. He worked actively for over a third of a century in India and contributed substantially to the building up of geological knowledge on various aspects of Indian geology. The void created by the loss will be difficult to fill as, in this age of specialisation, it will be exceedingly difficult for any individual to cover such a vast field as he has done.

Sir L. L. Fermor was born in London, on 18th September, 1880. After his school education at Wilson's Grammar School at Camberwell, London, he won a scholarship and entered the Royal School of Mines for studies in metallurgy. He won the first place in the First Class in the Associateship Examination of the Royal School of Mines in metallurgy in 1901 and was awarded the Murchison Medal for his proficiency. Later he took the B.Sc. Degree of London University by research and in 1909, after a few years of service in the Geological Survey of India, the D.Sc. Degree of the same University for his work on the manganese ore deposits of India. He was elected a Fellow of the Royal Society of London in 1934 in recognition of his many contributions to Indain geology.

After taking his Degree in the Royal School of Mines, he applied for a post in the Geological Survey of India and was selected in 1902 by a committee which included a well-known name in Indian geology, namely, W. T. Blanford. Though the training of Fermor was essentially in metallurgy, it was broad enough in those days for him to take to geology as his profession and make a great success of it. Within eight years of his joining the service during which time he was associated with such well-known geologists as T. H. Holland, C. S. Middlemiss and H. H. Hayden, he was promoted to the grade of Superintendent. On various occasions between 1922 and 1930 he officiated as Director. On the retirement of Sir Edwin Pascoe in 1930 he was appointed permanent Director and continued in that post till 1935 when he retired on superannuation

and was knighted by the Government of India for his distinguished services.

During the period of his Directorship, Fermor had to face the drastic retrenchment which overtook the scientific services in India in the early thirties. He fought hard to save the Department from serious retrenchment, but though he did not succeed to his satisfaction, the Department was nevertheless left with a nucleus which could carry on some of the functions of the Geological Survey till better times came.

Fermor's major interest was in Archæan geology and in igneous and metamorphic rocks. The greater part of his field work was devoted to the study of Archæan rocks in various parts of India, largely in connection with his monumental work on the manganese ore deposits. At a later date he started the detailed mapping of parts of the Chhindwara District in the Central Provinces, but the only publication which resulted from this was part of his treatise on the Archæans of India. His work on the manganese ore bodies which occupied six or seven years of the earliest part of his career was published in a monograph of four parts which appeared in 1909 as Volume 37 of the *Memoirs of the Geological Survey of India*. This established him as an authority on the manganese ores of India, for this treatise still holds the field and it will take many years to revise it and bring it up-to-date. This and his subsequent papers bear testimony to the accuracy of his observations, and to the enormous pains he was capable of taking both in the field and in the laboratory. Numerous younger officers have had the opportunity of being associated with him in their work on Archæan geology and all will to testify to his great industry, patience and meticulous care bestowed on observations. The study of the Deccan Traps led him to some important speculations concerning the interior of the earth and particularly about the existence of a layer of basic and ultra-basic rocks which might change their properties as a result of the conditions to which they are subjected at a depth of several miles from the surface.

Fermor's field studies included also the examination of the copper deposits of Singhbhum and of Sikkim ; the chromite deposits of Singhbhum and Baluchistan ; the coal deposits of the Korea and Bokaro coalfields ; the iron ores

of Ratnagiri and Goa; the Deccan traps of Linga, Chhindwara District, C.P.; the basaltic lavas obtained by boring at Bhusawal and others. The results have been published in his papers contributed to the Department's publications and elsewhere. He also brought together the information on the mineral resources of the C.P. and of Bihar which were published in separate papers in 1919 and 1921.

During the First World War, Fermor's services were placed at the disposal of the Government of India where he acted as Mineral Adviser to the Ammunitions Board. He was also a representative of the Government of India in several International Meetings such as the International Geological Congress in Sweden in 1910, in Canada in 1913, in Spain in 1925 and in South Africa in 1929.

He played a very prominent part in the advancement of science in India. He was a Founder Member of the Mining and Geological Institute of India and was connected with it in various capacities including the Presidentship of the body in 1922. He was elected General President of the Indian Science Congress Association in 1933 when he delivered an address on problems of ore genesis in the Archæans of India. He was connected with the Himalayan Club as a Founder-Member; he was the Trustee of the Indian Museum between 1930 and 1935; a Member of the Governing Body of the Indian Research Fund Association from 1932 to 1936; President of the Governing Body of the Indian School of Mines from 1930 to 1935; President of the Asiatic Society of Bengal from 1933 to 1936.

He was also connected with scientific institutions abroad. The Geological Society of London, of which he was a Fellow, honoured him with the award of a Bigsby Medal in 1921 and elected him to its Vice-Presidentship in 1945 to 1947. He was President of the Bristol Naturalist Society in 1945 and of the Institution of Mining and Metallurgy, London, in 1951-52. He was a Member of the Society of Economic Geologists (U.S.A.) and an Associate Editor of the well known Journal, *Economic Geology* for many years. He was also a Member of the Mineralogical Society of London.

Fermor played a very prominent part in the establishment of the National Institute of Sciences of India. He was Chairman of the Committee constituted by the Indian Science Congress for the establishment of that Institute and was its first elected President in 1935. Those who have watched him during the period of work of the Committee would pay tribute

to the patience and tact displayed by him in solving the many difficulties which arose.

During the period of his retirement, after 1936, he was living in England, but took active part in the working of the Mineralogical Society, Geological Society and the Institute of Mining and Metallurgy in that country. He was also practising as a Consultant Geologist and paid visits to East Africa, South Africa and Malaya. He visited India in 1938 as a Member of the Delegation from the British Association for Advancement of Science to the Silver Jubilee Session of the 25th Indian Science Congress. In 1951 he was invited by the Government of India to the Centenary Celebrations of the Geological Survey of India, and he contributed an article on the history of the Geological Survey during its first 25 years from 1851 to 1876.

During the last few years of his service he began publishing parts of what he intended to be a comprehensive work on the Archæan geology of India. Unfortunately, only some four parts out of the projected 18 have been published. But those parts give an idea of his great and profound knowledge of the subject and it is regrettable that the work will now remain uncompleted.

Fermor was gifted with a capacity for taking enormous pains and going into the details of any problem referred to him for study. He was a hard task-master, but was always considerate and ready to give a patient hearing to even the most inexperienced colleague. It was very instructive to accompany him in the field for he was always ready to discuss and instruct, with his keen powers of observation and deduction. He was responsible for the starting of a departmental scientific club in which the officers explained to their colleagues the work on which they were engaged and which was debated upon. This geological club is still functioning vigorously in the Department.

Fermor is perhaps the last of the generation of geologists who may be called pioneers of Indian geology. He and his contemporaries, namely, C. S. Middlemiss, H. H. Hayden, R. D. Oldham, E. W. Vredenburg, G. E. Pilgrim and T. H. Holland have contributed a great deal to the understanding and solution of geological problems. With the passing of that generation closes the era of study of the broader problems of Indian geology. On the foundation laid by these and other earlier pioneers will the superstructure of Indian geology be built in generations to come.    M. S. KRISHNAN.

# LETTERS TO THE EDITOR

## PERIODIC FADING OF MEDIUM WAVE RADIO SIGNALS

PERIODIC fading in short and medium wave signal strength records of distant transmitters taken during the early morning and late evening hours, was interpreted by previous investigators[1,2] as due to the interference between two waves reflected either from one or two different layers of the ionosphere when one or both the layers have a slow vertical movement. They have calculated the vertical velocities of both the layers from the observed fading periodicities present in the records but their values showed wide variations. Further, it has not been possible for them to confirm these results by obtaining velocities by any other methods.

We have therefore undertaken a more detailed investigation on the determination of the

layer movements in the E-layer using medium wave transmissions. Using conventional equipment for recording signal strengths of continuous waves, fading records have been obtained for Madras A, Madras B and Cuttack medium wave transmissions during 0700-0800 hours. Almost all the records have shown complex periodic fading which is a superposition of three different types of periodic fading. Detailed analysis of the records revealed that there are two types of comparatively slow periodic fading and one type of a fairly quick period fading. All the three types of fading are interpreted as due to the interference of the three reflected waves from the E-layer. The slower periodicities correspond to 1 E & 2 E and 2 E & 3 E interference, whereas the quick period fading corresponds to the 1 E & 3 E interference. On the basis of this interpretation, the layer lifting velocities

are calculated from each of these periodicities and the values are found to be 2·15 metres per second for 1 E & 2 E interference, 2·29 m/s for 1 E & 3 E interference and 2·34 m/s for 2 E & 3 E interference. These values are found to be in good agreement with each other confirming the interpretation given by us. Further confirmation is obtained by the fact that both the 1 E & 3 E and 2 E & 3 E types of fading have lesser amplitude in view of the fact that the third hop from the E-layer is comparatively weak.

In the fading records obtained with Cuttack medium wave radio signals, the periodicities due to ground wave interference have also been noticed, possibly due to the appreciable signal strength of ground wave, Cuttack station being nearer (412 km.). The velocities as calculated from this periodicity are found to be in good agreement with the values obtained from the fading periodicities due to 1 E & 2 E interference. The average value of the velocity is about 2·37 m/s.

An important feature which has not been hitherto noticed is the decrease of velocity with time in the morning hours noticed in some of the records analysed. The analysis of such records is done by dividing it into four parts and taking the average velocity obtained from the different modes of interference present in each part. It is found that there is in general a definite decrease of velocity with time. At times, the variation is as much as 5 m/s to 2 m/s. It is evident from the above observation that the movement of the layer is rapid at the formation time during early morning hours and that it will gradually attain stable level after some time in the morning. Also it is found in most of the records that the amplitude or depth of fading decreases with time which can be explained as due to the increasing absorption of the radio waves in the intervening D-layer due to its growth in the early morning hours. Full details of these investigations will be published elsewhere.

B. RAMACHANDRA RAO.
N. V. GURUNADHA SARMA.
Physics Dept.,
Ionospheric Laboratories,
Andhra University, Waltair,
*July* 3, 1954.

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2. Khastgir, S. R. and Das, P. M., *Proc. Phys. Soc.*, 1950, **63**, 924.

## DETECTION EFFICIENCY OF A PARALLEL PLATE COUNTER WITH GAS FILLING

THE counter used for these experiments has been described earlier.[1] In these experiments its detection efficiency for cosmic rays was measured by means of a coincidence circuit with the usual Geiger-Muller counter. For the present experiments a radioactive source, equivalent to 0·44 mg. Ra at a distance of 16 cm. from the lower plate was used. A special feature of the p.p. counter was the facility to adjust the parallelism of electrodes under applied high voltage, by which the field distribution in gap between electrodes was rendered uniform, thus effecting maximum utilisation of the electrode surface. High voltage on the counter was supplied by a stabilised h.v. rectifier from which voltage could be tapped at 2,000, 4,000, 6,000 and 8,000 volts. Fine adjustment of voltage on counter was achieved with the help of a dry cell battery of 700 volts, with tappings, connected in series with the rectifier. A simple thyratron circuit with slightly modified telephone call counter was used for counting the discharges (impulses). The influence of occasional radioactivity in the laboratory was eliminated by placing the counter in a lead box covered with thin aluminium sheet, which provided also electrostatic shielding.

Three easily available gases of different chemical nature (oxygen, carbon dioxide and air), were used for filling the p.p. counter. Some additional measurements were also made with nitrogen and argon. The gases had a purity of about 95 per cent. and were dried by passing through a vapour trap cooled with a mixture of dry ice and spirit (about $-80°$ C.). The experiments were made for each gas for four values of distance between electrodes ($d$): 3, 6, 10 and 20 mm. and with four voltage values (V) approximately 2,000, 4,000, 6,000 and 8,000 volts for each distance. For each voltage (V) the pressure of the gas was adjusted so that the discharges just started to pass through and then measurements were made of the variation of counting rate with voltage over a range ($\Delta V$) of about 700 volts near V. Fig. 1 gives the variation of the number of counts per minute (counting rate) with the change in voltage ($\Delta V$) for four values of V with the gas $CO_2$. The curves obtained with other gases are similar, but the exact shape varied with the gas used. Since the number of counts per minute can be taken approximately as a measure of the current passing through the p.p.

counter, these curves may be considered to be the current-voltage characteristic of the counter. Fig. 1 also exhibits the variation with $\Delta V$
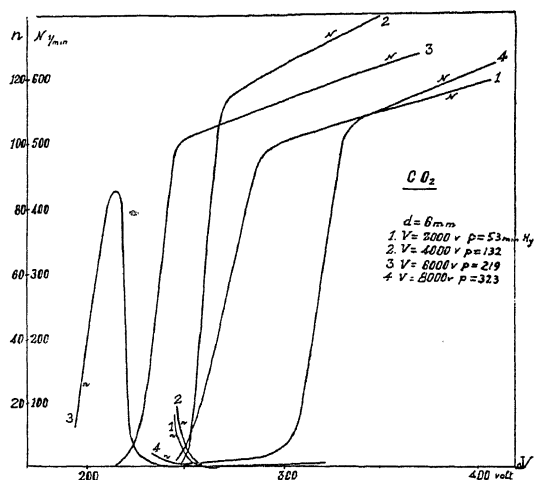


FIG. 1. Variation of Detection Efficiency and Impulse Number with Voltage Change.

of detection efficiency $(n)$ defined by

$$n = (N_2 - N_1)/N_1.$$

Here $N_1$ is the number of counts per minute without the radioactive source and $N_2$ the number of counts with it. The individual points in Fig. 1 have a relatively large probable error, of the order of 40 per cent. which is partly due to the statistical errors and partly due to the fact that the stabilisation of h.v. rectifier was not good enough. However, the general trend of the data in Fig. 1 is clear enough. In all these curves it is noticed that $n$ reaches its highest value $(n_{max.})$ for relatively low value of N, very close to the point where the discharge just starts. Apparently, with the increase of voltage on the p.p. counter, even weak primary ionisation tends more and more to develop itself into discharges, increasing the number of occasional discharges (not produced by the action of the radioactive source), and consequently increasing the total dead time of the counter. This reduces the probability of development of discharges for primary ionisation caused by radioactive source and thus finally results in the decrease of $n$.

The average maximum detection efficiency for a distance $(\bar{n}_{max.})$ was calculated by taking the average of $n_{max.}$ for the four values of the voltage. The variation of this quantity with the distance between the electrodes is given in Fig. 2. In addition to the curves representing results of measurement with three gases mentioned above, the figure contains also one curve for argon-

alcohol mixture drawn on the basis of results of measurements with cosmic rays reported earlier. The numbers over the points give rela-
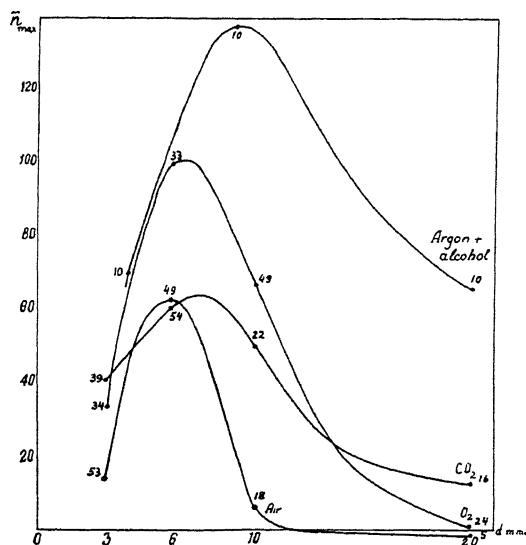


FIG. 2. Average Detection Efficiency as Function of Distance Between Electrodes.

tive errors in per cent. It can be seen from the curves that for each of the four gases of different chemical nature, the detection efficiency has a maximum value, and that it varies with different gases. In the voltage range between 2,000 and 8,000 volts the position of the maximum in the $n$-$d$ curve varies between 5 and 10 mm. for the gases studied. The existence of a maximum in these curves may be explained as being due to two opposing factors. For a limited voltage range, with the increase of $d$, the probability of discharge development increases with the increase in thickness of gas layer (which increases the volume of possible ionisation and therefore the probability of discharge development also) while on the other hand it decreases with the decrease in field strength $(V/d)$, which is the governing factor for the development of primary ionisation into a discharge.

These experiments were conducted in 1950-51 in the Physical Institute of the Hamburg University. I am indebted to Prof. Dr. E. Bagge for giving me facilities for the work.

Madras,            A. SUSZKIN.
*July* 7, 1954.

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## LOW TEMPERATURE CARBONISATION ASSAY OF SOUTH ARCOT LIGNITE

A SAMPLE of about one cwt. of lignite received from the Lignite Mines, Neyveli, was employed for this work. The proximate analysis of the lignite which was determined by standard methods is given in Table I.

### TABLE I
*Proximate analysis*

|   |   | Air dry basis as received | Moisture-free basis |
|---|---|---|---|
| 1 | Moisture | 15·7 % | .. |
| 2 | Volatile matter | 48·8 % | 57·9 % |
| 3 | Ash | 3·28 % | 3·89 % |
| 4 | Fixed carbon (by difference) | 22·2 % | 38·21 % |
| 5 | Sulphur (Eschka method) | 0·78 % | 0·93 % |
| 6 | Nitrogen | 0·523 % | 0·62 % |
| 7 | Calorific value (BTU/lb.) | 9350 | 11090 |

The low-temperature carbonisation assay was carried out with the lignite ground to − 80 mesh and dried to constant weight at 105–110° C. The Gray-King Assay apparatus using an electrically heated tube-furnace was employed for the work. The temperature could be controlled automatically with the help of a Temcometer input controller to ± 5° C. 20 g. of moisture-free lignite were used for each experiment, the tar and liquor obtained being collected in a water-cooled condenser, whereas the gas, after scrubbing free of ammonia with dilute sulphuric acid, was collected over a glycerine-water mixture. The rate of heating was carefully controlled so that the final carbonisation temperature was reached at the end of an hour. Then the carbonisation was carried on at this temperature till the gas evolution became negligible, a period of nearly 2 hours being required for the process. The experiments were carried out at various temperatures ranging from 500–750° C. The characteristics of the chars obtained are given in Table II.

### TABLE II
*Proximate analysis of char*

| Temp. of carbonisation ° C. | Moisture-free basis | | | Cal. value BTU/lb. |
|---|---|---|---|---|
|   | V.M. % | Ash % | Fixed C by diff. % |   |
| 500 | 22·3 | 5·6 | 72·1 | 14800 |
| 600 | 8·8 | 6·0 | 85·2 | 14110 |
| 700 | 5·7 | 7·8 | 86·5 | 13920 |

The yields of the various products, namely, char, tar, liquor, gas (ammonia-free) and of ammonia obtained in the various experiments are shown in Table III.

### TABLE III
*Low temperature carbonisation assay
Yields of products at various temperatures
per 100 g. of moisture-free lignite*

| Temp. ° C. | Char (g.) | Tar. (g.) | Liquor (c.c. = g.) | Gas (Ammfree) c.c. 29° C. | Ammonia (g. of Amm. sulphate) |
|---|---|---|---|---|---|
| 500 | 58·6 | 10·2 | 10 | 16000 | 0·0222 |
| 550 | 50·0 | 12·0 | 10 | 20000 | .. |
| 600 | 48·8 | 13·9 | 10·5 | 23320 | 0·0243 |
| 650 | 48·3 | 14·4 | 10 | 25300 | .. |
| 700 | 47·2 | 14·7 | 11 | 25200 | 0·0466 |
| 750 | 47·3 | 15·0 | 11 | 26900 | .. |

The calorific value of the gas obtained on carbonisation at 600° C. was also determined using a Jones-Miller Gas calorimeter. A mean value of 222 C.H.U. per cu. ft. (N.T.P.) was obtained.

With the increase of the temperature of carbonisation the yields of gas, tar and ammonia increase while that of the char decreases, and this variation is most marked in the range 500–600° C. of the carbonisation temperature. It was found that the time taken for attaining the final carbonisation temperature affects the yield of the gas generated, quicker heating increasing the yield especially in the range 450–600° C.

The low calorific value of the gas when compared to coal gas is due to the higher carbon dioxide and lower hydrocarbon contents of the gas. This is to be expected because lignites, as a rule, contain a higher percentage of oxygen, than coals.

A detailed paper on the results of this investigation will be published elsewhere.

Chem. Tech. Labs.,          S. SUBRAHMANYAN.
A. C. College of Tech.,   A. P. MADHAVAN NAIR.
Madras-25, *August* 2, 1954.

## ON A NEW FOSSILIFEROUS LOWER GONDWANA PATCH IN BANKURA DISTRICT, W. BENGAL

IN the course of a recent (1949–50, 1952–53) geological and mineral survey in the Bankura District, the author noticed a new fossiliferous Lower Gondwana patch extending over an area of more than 6 square miles. The patch lies between lat. 23° 15′ and 23° 27′ and long. 87° 13′ and 87° 17′ 30″ approximately included in the Survey of India topo sheets 73 M/3 and 73 M/7 (scale 1″ = 1 mile).

formations comprise grey and reddish
10us shales overlain by coarse to medium-
yellowish and greyish-white felspathic
1es; the latter are sometimes seen to
to coarse ferruginous sandstones near
'ace. An impersistent layer of a pebbly
)ut 2-3′ thick and mostly composed of
nded and rounded bluish and white
e pebbles (ranging upto 2½-3″ in dia-
occurs in the sandstones overlying the
y shales. This pebbly horizon possibly
; some break in sedimentation.

)eds are almost horizontal or dipping
owards south-east and S.S.E. at angles
from 5-10° in most of the exposures.
ially, higher dips ranging from 15-25°
directions such as towards east, north-
north have also been noted.

:rey shales contain somewhat obscure
ssils, while the reddish shales show dis-
nt fossil impressions. The fossils found
shales are:

pteris    indica,    *Glossopteris    retifera,*
2ris    communis,    *Gangamopteris    (?)*
oids, *Samaropsis raniganjensis, Cordai-*
pecies and also *Vertebraria.*

.ing to Dr. K. Jacob, Palæobotanist,
ıl Survey of India, "this assemblage of
sils indicates that the beds in question
: probably Barakars and in any case
ger than the Raniganj". On the basis
ithological and fossil evidences, these
ear to belong to the Barakar stage of
uda series.

:posed thickness of these beds as re-
ı the stream and well sections of the
1ot exceed 30-35′. The true total thick-
ıe formation could not however be as-
owing to the absence of any rele-
ı (boreholes, etc.) but is likely to be

ondwana patch is surrounded on its
es by laterites and patches of allu-
is probable that the Gondwana beds
y to be found extending under the
laterites and some of the newly
rtiary formations. As such their areal
ay be considerably more than their
:tual exposures.

· of the possible Barakar age of these
nd Lower Gondwanas extending over
large area, the author suggests that
y boring in the area may be worth
ıg to investigate the possible pre-
:oal seams (not exposed) at depths.

Survey of India,          A. HUNDAY.
3, *June 28, 1954.*

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## EFFECTS OF FOLIC ACID AND VITAMIN $B_{12}$ ON DEGRADATION OF PURINES BY *LACTOBACILLUS CASEI*

IT is recognized that folic acid and vitamin $B_{12}$ influence the synthesis of nucleic acids in micro-organisms[1,2] presumably through media-tion in reactions leading to formation of purine and pyrimidine bases.[3] The possibility is not excluded that the vitamins may also function by inhibition of purine breakdown reactions which result in formation of ammonia, acetic acid and carbon dioxde.[4] *In vivo* and *in vitro* inhibition of xanthine oxidation by folic acid is known.[5,6] A study was therefore made of the oxidative decomposition of xanthine and adenine by *Lactobacillus casei* (A.T.C.C. 7469) and the effects on it of folic acid and vitamin $B_{12}$ supplied in the growth medium.

The techniques of culturing and harvesting were as described before.[2] The degradation of the purine bases was followed from the libera-tion of ammonia as a result of the action of the resting cells in Conway micro-diffusion units.[7] The system contained in a final volume of 3 ml., 1 ml. of cell suspension (24 hours harvest), 1 ml. of 0·2 M phosphate buffer, pH 7·4, and 0·5 ml. of substrate equivalent to 1 mg. of the purine. After incubation for 3 hours at 37° C., 1 ml. of a saturated solution of potassium carbonate was added and the tightly sealed unit kept at 37° C. for 1½ hours. The ammonia liberated was quantitatively ab-sorbed in the central well in 2 N sulphuric acid and estimated by direct nesslerization.

The results using xanthine and adenine as substrates and with cells grown in media con-taining varying amounts of folic acid and/or vitamin $B_{12}$ are given in Table I. Corrections were made for endogenous release of ammonia.

TABLE I

*Effects of folic acid and vitamin $B_{12}$ on purine degradation in* Lactobacillus casei

| Supplements per 100 ml. growth medium | | $NH_3$ per mg. dry wt. cells in the presence of | |
|---|---|---|---|
| | | Xanthine | Adenine |
| Folic acid 5 m$\mu$g. | ·· | 11·6 | 19·8 |
| Folic acid 200 m$\mu$g. | ·· | 7·4 | 18·2 |
| Vitamin $B_{12}$ 5 m$\mu$g. | ·· | 9·3 | 18·6 |
| Vitamin $B_{12}$ 200 m$\mu$g. | ·· | 7·5 | 17·6 |
| Folic acid + Vitamin $B_{12}$ 200 m$\mu$g. each | | 10·4 | 17·9 |

Cells grown in presence of excess of folic acid or vitamin $B_{12}$ were less active in purine degradation. This was observed better in case of xanthine. The increased ammonia forma-tion and the less pronounced effects of the

vitamins with adenine may probably be due to its primary amino group in the deamination of which these vitamins might have no influence. This was also inferable from the fact that the aspartic deaminase activity of the organism was not influenced by the two vitamins. The deamination of adenine in *Escherichia coli* is known to be preceded by transamination with inosine forming adenosine.[8]

Essentially similar results on the effects of folic acid and vitamin $B_{12}$ were observed in studies involving determination of acetic acid.

The depressing effect of folic acid and vitamin $B_{12}$ on purine catabolism is relatively less pronounced than their stimulation of nucleic acid synthesis.[2]

One of us (DVR) is indebted to the Raptakos Medical Research Board for the award of a fellowship.

Dept. of Chem. Tech.,        D. V. Rege.
University of Bombay,         A. Sreenivasan.
June 2, 1954.

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## STANDARDS FOR INDIAN COFFEE

A survey of Food Laws[1] of various Indian States shows a wide disparity between inter-State specifications for coffees and in certain States, complete specifications have not been laid down. It was therefore considered necessary to obtain authentic data on the chemical composition of coffee grown in different regions of the country with a view to specifying uniform standards. The present study relating to the regional, varietal and type differences in the chemical composition of Indian coffee was undertaken on behalf of the Indian Coffee Board. The data presented in the present paper have been collected over a period of two years. In the meantime, two reports[2,3] on the analytical figures for Indian coffee have appeared.

Forty samples belonging to *Arabica* variety and twenty belonging to *Robusta* were obtained through the courtesy of the Indian Coffee Board, from various regions of growth, namely,

Nelliampatti, Nilgiris, Annamalais, Kannandevan, Pulneys, Bababudan, Shevaroy, Coorg, Biligiris and Naidubattam. All the samples were of Fair Average Quality (F.A.Q.). The coffee seeds were roasted in an electric coffee roaster to a medium roast and powdered ; the powder passing through 30-mesh sieve was used for the analysis. Standard A.O.A.C. methods[4] were followed except in the case of water extract. Water extract was determined by Jone's method,[5] and tannins by indigo carmine method[4] as used for tea.

The average chemical composition and range of analytical values for different coffees are given in Table I. Full details of the data on the regional, varietal and type differences in the chemical composition of coffee will be published elsewhere, but the salient features are as follows :

TABLE I

*Average chemical composition of coffee powder*
(40 samples—*Arabica* ; 20 samples—*Robusta*)

| | C. *Arabica* | | C. *Robusta* | |
|---|---|---|---|---|
| | Mean % | Range of values % | Mean % | Range of values % |
| Loss on roasting | 15·4 | .. | 15·3 | .. |
| Moisture | 2·5 | .. | 2·62 | .. |
| Total ash | 4·20 | 3·7 –4·6 | 4·45 | 4·1 –4·7 |
| Water-soluble ash | 3·22 | 2·64–3·86 | 3·38 | 2·95–3·77 |
| Water-insoluble ash | 0·98 | .. | 1·07 | .. |
| Alkalinity of soluble ash (c.c. of N HCl/100 g.) | 36·8 | 28·0–46·4 | 37·2 | 30·0–44·8 |
| Total N | 2·52 | 2·2– 2·8 | 2·83 | 2·3– 3·1 |
| Crude protein (non-caffein N×6·25) | 13·02 | 10·1–15·0 | 14·96 | 11·0–17·0 |
| Caffeine (caffeine N×3·464) | 1·19 | 1·0– 1·64 | 1·43 | 1·16–2·09 |
| Pet ether extract | 14·60 | 11·4–17·5 | 9·62 | 8·4–11·6 |
| Crude fibre | 17·30 | 14·6–22·2 | 18·13 | 14·3–21·3 |
| Tannins | 2·33 | 1·6– 4·14 | 3·18 | 1·8– 5·58 |
| Water extract | 29·3 | 26·3–32·9 | 29·8 | 28·1–31·7 |

(1) In general, no significant difference in the proximate composition is evident among the various types of coffee as cherries, plantation, flats and peaberry belonging to either *Arabica* or *Robusta* variety. The superiority in cup quality of plantations and peaberries over other types seem to be mainly in their taste and aroma.

(2) Regional differences in certain constituents have been observed as follows: (*a*) *Robusta* samples from Bababudan and Coorg showed maximum tannin content (4·86 and 3·96 per cent. respectively). It is worthwhile to study

| Constituent | Not less than % | Not more than % |
|---|---|---|
| 1 Total ash | 3·5 | 4·8 |
| 2 Water-soluble ash | 65% of total ash | .. |
| 3 Acid-insoluble ash .. | trace | .. |
| 4 Alkalinity of soluble ash (ml. N HCl/100 g. powder) | 30 | 47 |
| 5 Water extract (Jone's method) | 26 | 33 |
| 6 Caffeine | 1·0 | .. |
| 7 Total Nitrogen | 2·2 | 3·1 |

if the quality of coffee is influenced by its tannin content. (b) The tannin content of *Arabica* samples from Shevaroy, Biligiri, Annamalai and Coorg is slightly higher (2·55-3·2 per cent.) than that of samples from other regions (1·8-2·45 per cent.). (c) The total nitrogen content of *Arabica* samples from Biligiri, Pulney, Bababudan and Coorg (2·58-2·72 per cent.) is slightly higher as compared to the samples from other regions (2·26-2·54 per cent.). (d) *Robusta* samples from Nelliampatti have shown the maximum content of caffeine (2·03 per cent.). Samples from Nilgiri and Annamalai have also shown higher caffeine content as compared to other regions (caffeine content of certain samples of Indain coffee has been found by Venkatachalam and Sundaram[6] to be as high as 2·2-2·6 per cent.).

Based on our above data, the tentative standards proposed for Indian Coffee are given in Table II.

Acknowledgements are due to the Indian Coffee Board under whose auspices this work was conducted.

Division of Food   V. Subrahmanyan.
  Processing,      D. S. Bhatia.
Central Food     C. P. Natarajan.
  Tech. Inst.,    G. S. Mani.
Mysore,          J. R. Iyengar.
*July* 8, 1954.  (Miss) M. Nagarathnamma.

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# THE NATURE OF THE OXYGENATED ACID FROM THE SEEDS OF *VERNONIA ANTHELMINTICA* (WILLD.)

In connection with the examination of oils showing abnormal values, work on this oil was commenced some time back and had almost reached completion, when a paper on the same topic was published by Gunstone.[1] The oil, obtained by extracting the seeds with benzene, was saponified with alcoholic potash, unsaponifiables removed, and mixed acids isolated. The lead salts of the mixed acids were subjected to repeated separation. The saturated acids were removed as the alcohol-insoluble lead salts and the alcohol-soluble lead salts repeatedly treated with light petrol and the insoluble portion decomposed with hydrochloric acid, esterified with ethyl alcohol-sulphuric acid and then acetylated by refluxing with acetic anhydride. The acetylated ester was purified by fractional distillation and gave an almost colourless oil, b.p. 232-34°/5 mm. The acid liberated had a saponification equivalent of 312·6, corresponding to 314 for dihydroxy octadecenoic acid. It is known that carboxylic acids will open the oxide ring. Thus, it is possible to convert an epoxide to the glycol monoacetate with acetic acid or to a monovalerate with valeric acid.[2] Thioacetic acid has also been used in this way.[3] The present work shows that like acetic acid, acetic anhydride can also function in a similar manner. Periodic acid oxidation of the hydroxy acid yielded *n*-hexanal, also reported by Gunstone.[1] The acetylated ester was reduced with Adam's catalyst and then saponified to give dihydroxystearic acid, which was further reduced with P-HI to stearic acid. The same hydroxystearic acid was obtained by Gunstone[1] on reduction of the hydroxylated acid (obtained from the epoxy acid with acetic acid direct) with palladised carbon. The dihydroxystearic acid on periodate oxidation gave *n*-hexanal and an aldehydoacid, m.p. 64-66°, which on permanganate oxidation yielded *n*-dodecanedioic acid. Acetone-permanganate oxidation of the acetylated ester afforded azelaic acid and another acid which is under examination. Performic acid oxidation on the acetylated ester, followed by saponification, yielded two isomeric tetrahydroxy stearic acids of m.p. 123-25° and 146-48°, which are under further examination along with another tetrahydroxy stearic acid of m.p. 162-64° obtained by cold, dilute alkaline permanganate oxidation of the unsaturated acid resulting from the hydrolysis of the acetylated ester. The results presented here are complementary to those recorded by Gunstone[1] and

fully confirm his conclusion that the acid in question is 12 : 13-epoxy-octadec-9-enoic acid.

Maharaja's College,                    P. S. RAMAN.
Ernakulam, *August* 7, 1954.

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## EFFECT OF IODINATED CASEIN ON GROWTH IN CALVES

IODINATED proteins have been reported to stimulate growth in young growing pigs, mice, guinea pigs and chicks (Blaxter *et al.*[1]). Trials with young heifers have not shown uniformly favourable results. Amongst the published literature only Millen *et al.*[2] and Dyrendahl[3] report some improvement in growth in calves. The subject is of considerable interest in this country, as Indian animals have ordinarily slower growth rate than the Western breeds, and iodinated protein feeding might be of practical benefit.

In a previous communication by Sen *et al.*[4] it was shown that calves fed iodinated casein at the rate of 2 g./100 lb. body weight exhibited a marked retardation in growth compared to the controls. This was accompanied by lower retention of N. An indication was also obtained that when the dose was reduced from 2 g. to 1 g., a sudden spurt in growth occurred. The present study was, therefore, planned to determine the effect of small amounts of iodinated casein on the growth of calves. Fifteen calves varying in age from 255 to 407 days were divided into 3 groups of 5 each. One group was kept as control and other two, Groups A and B, were given 1·25 g. and 0·75 g. respectively of iodinated casein per 100 lb. live-weight. At the end of the 12 weeks of treatment, the animals in Group B registered an increase in live-weight by an average of 75 lb. per animal as compared to 51 lb. by the control. This difference in growth rate was found to be statistically significant. During the same period, the animals in Group A also exhibited a higher growth rate (61 lb.) than the control, but the difference was not found statistically significant. All the thyro-protein administered animals, irrespective of being in Group A or B, showed statistically significant higher growth rate than the control when the treatment was prolonged to 20 weeks. The average daily rate of growth in 20 weeks in

controls, Group A and B was 0·65, 0·85 and 0·90 lb. respectively. At this stage, the administration of iodinated casein was withdrawn from the animals in Group A, whereas for those in Group B, it was increased at the rate of 2 g. per 100 lb. live-weight. The animals in Group A were found to maintain their relatively higher growth rate than the control for the next 15 weeks of observation. The increased administration of thyro-protein to Group B brought about definite retardation in growth within about 10 weeks, the daily average growth rate being 0·41 lb. It may be mentioned here that these experiments were carried out under a relatively temperate climate when the variation of temperature was between 86-55° F. and humidity 49-59 per cent.

These observations thus show that it is possible to accelerate growth in heifers by administering small doses of iodinated casein, whilst larger doses have adverse effect. Both control and experimental animals were given the same ration in proportion to their body weights. The results indicate improved food utilisation in presence of small doses of iodinated casein.

Indian Dairy Res. Inst.,      K. C. SEN.
Bangalore-1,                  B. N. PREMACHANDRA.
*July* 2, 1954.              NOSHIR N. DASTUR.
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## HORMONES AND ROOTING IN INTACT PLANTS AND CUTTINGS

THE investigations carried out and reported here relate to : (*a*) the rooting response of intact shoots of some common herbaceous and shrubby plants to different hormones and (*b*) to the root producing effect of indole butyric acid (IBA) and L-naphthalene acetic acid (NAA) on the cuttings of some common trees and shrubs.

*Intact Shoots.*—In intact shoots the hormones were applied by lanolin paste method. Lanolin paste containing hormones was applied 10 cm. below the apex of the stem in a 1·5 cm. broadring. In case of *Carica papaya* L. and *Corchorus* Spp., hormones in lanolin paste were applied on the lateral branches obtained after

TABLE I

| Material studied | Month of expt. | Hormones | Effective range of concentration % | *% Rooting treated : untreated | Rooting time in days | General effect of rooting |
|---|---|---|---|---|---|---|
| *Carica papaya* L. | Aug.–Oct. | IBA | { 3·0 | 100 : 0 | 33 | +++ |
| | | | { 5·0 | 100 : 0 | 31 | ++ |
| | do | NAA | .. | .. | .. | 0 |
| *Corchorus olitorius* L. | June–Aug. | IBA | | | | |
| | do | NAA | { 5·0 | 100 : 0 | 19 | +++ |
| | | | { 10·0 | 100 : 0 | 18 | ++++ |
| *Corchorus capsularis* L. | do | IBA | .. | .. | .. | 0 |
| | do | NAA | 5·0 | 100 : 0 | 20 | ++ |
| *Crotalaria juncea* L. | do | IBA | .. | .. | .. | 0 |
| | do | NAA | { 5·0 | 100 : 0 | 22 | + |
| | | | { 10·0 | 100 : 0 | 21 | ++ |
| *Hibiscus subdariffa* L. | do | IBA | .. | .. | .. | 0 |
| | do | NAA | .. | .. | .. | 0 |
| *Lycopersicum esculentum* L. | July–Aug. | IBA | 2·0 | 100 : 0 | 19 | ++ |
| | do | NAA | { 1·0 | 100 : 0 | 15 | +++ |
| | | | { 1·5 | 100 : 0 | 21 | ++ |

* Proportion of rooting in treated branches to the untreated control.
  0 : nil, + < 5, ++ : > 5  +++ : > 10, ++++ : > 15.

apical decapitation. The number of branches treated varied between five and ten. A summary of the effects of the different treatments on the production of roots in intact shoots is given in Table I.

In case of intact plants it is clear from the general responses of woody and herbaceous species that woody plants in general require a higher concentration of hormones than the herbaceous ones and thus the concentration requirements varied according to the nature of the plant.

*Cuttings.*—The effect of indole butyric acid and L. naphthalene acetic acid on the rooting of the cuttings of *Euphorbia pulcherrima* Willd., *Mangifera indica* Linn., and *Eugenia jambolana* Lamk. was investigated. Green wood cuttings (18 cm. long with intact apical region) were treated with hormones by standard immersion method (24 hours) and concentrated dip method (10 secs.). Experiment was conducted during summer (June–July), monsoon (August–October) and winter (November–January) seasons of the year. Concentration varied between 5 ppm. to 8 ppm. in standard immersion method and 2 mg./ml. to 10 mg./ml. in concentrated dip method. One set of the cuttings were planted in sand and the other in soil and there were three cuttings for each treatment.

There was induction of rooting in the cuttings of *Euphorbia pulcherrima* Linn.—when treated with Indole butyric acid (5 ppm. to 10 ppm.) during summer and monsoon seasons, and only when the cuttings were sown in the soil medium. In this plant there was no response in winter with any of the hormones and L. naphthalene acetic acid failed to induce rooting in any of the treatments and seasons. In *Mangifera indica* Linn. and *Eugenia jambolana* Lamk. there was no response in any of the treatments.

From the responses towards rooting of different plants it is clear that relative effects of indole butyric acid and L. naphthalene acetic acid vary considerably according to genera and species, as also pointed out by Hitchcock and Zimmerman.[1]

The rooting response is expected to be intimately related to the penetration of hormones through the epidermis and cortex up to the pericyclic region, which is probably the reason why a comparatively higher concentration is required in case of woody species.

It is worthwhile mentioning that there are many plants which have not responded to auxin treatment in the production of roots. The reason for this appears to be not due to want of auxin, but rather to the lack of proper co-factors. Cooper and Stoutemeyer, Van Overbeek and others have shown clearly the importance of the presence of leaves on cuttings for the production of roots. Leaves can thus be said to provide co-factors which together with auxin cause root formation. Thus the elucidation of the relation between the nutritional condition of the cuttings and its capacity for rooting might prove useful, as was also pointed out by Sen.

Botanical Laboratory,       J. C. SEN GUPTA.
Presidency College,       S. K. CHATTOPADHAYA.
Calcutta, *March* 5, 1954.

1 Hitchcock, A. E. and Zimmerman, P. W., *Contrib. Boyce Thomp. Inst.*, 1940, **11**, 43.

## RELATIVE TOXICITY OF SULPHA-DRUGS TO WHEAT

SULPHONAMIDES are known to inhibit root-growth in the higher green plants.[1-5] Spraying of wheat-seedlings with the drug solution leads to chlorosis and even necrosis.[6] The effect varies with the drug and its concentration.[4] In the present studies, relative toxicity to wheat plants, of some sulpha-drugs (Irgafen, Sulpha-mezathine, M.B. 693, Sulpha-thiazole, Cibazol, Sulphatrid, M.B. 760, Sulpha-diazine, Septanelam and Sulpha-guanidine) has been investigated.

Grains of wheat (N.P. 165) were soaked (partly immersed) in 1 per cent. solution of the drug for (*i*) 24 hours and (*ii*) 48 hours and were immediately sown in soil in pots, the former in one half and the latter in the other half of each pot. Controls, soaked in water, were maintained. Observations on sprouting during soaking, germination in soil, growth and maturity were noted. Results with Irgafen and S-mezathine are presented in Table I. With the remaining drugs, in spite of satisfactory sprouting (the percentages varying between 82 and 100), germination was low (below 45 per cent.), and all the seedlings died soon.

TABLE I

|  | Control | | Irgafen | | Sulpha-mezathine | |
|---|---|---|---|---|---|---|
| Soaking period (hrs.) | 24 | 48 | 24 | 48 | 24 | 48 |
| Sprouting % | 94 | 100 | 92·5 | 92·5 | 85·0 | 85·0 |
| Germination % | 95·0 | 90·0 | 70·0 | 65·0 | 60·0 | 45·0 |
| Mortality % | nil | nil | 28·6 | 23·0 | 16·6 | 11·1 |
| Earing (days) | 58 | 59 | 88 | 89 | 96 | 100 |
| 1,000 grain wt. g. | 42·0 | 35·0 | 26·0 | 19·0 | 26·0 | 18·0 |

Even with such a high concentration of the drugs (1·0 per cent. solution), maximum inhibition in sprouting amounted only to about 18 per cent. but germination in soil was adversely affected, and the seedling mortality was high. The primary roots were stumpy and ageotropic; plumule-growth was slow and distorted; the first leaves were markedly succulent, dark green and narrow; tillering was induced early. Recovery in shoot-growth occurred after six weeks and the later growth was vigorous with normal foliage. Earing was delayed by 30 days with Irgafen and by 38 days with S-mezathine. Grain yields could not be compared due to unequal stand in the control and treated sets. However, 1,000 grain-weight indicates that the treatments led to shrivelling of grain.

Earlier workers,[1-4] who observed inhibition in root-growth by sulphonamides in low concentrations (0·001 to 0·01 per cent.) grew the seedlings in test-tubes or petri-dishes with a continuous supply of the chemical; thus, results on growth and maturity were not available. The present technique of pre-sowing soaking does not seem to have been tried so far with these drugs.

Audus and Quastel[4] observed that, at a concentration of 0·001 per cent., sulphanilamide and sulphapyridine were more toxic to root-growth than sulphaguanidine and sulphathiazole. In the present studies, the relative toxicity of the drugs appears to be : S-guanidine > Septanelam > M.B. 760 > S-diazine > S-trid > S-thiazole > Cibazole > M.B. 693 > S-mezathine > Irgafen. Experiments with lower concentrations than 1·0 per cent. are in progress.

Botany Dept.,      S. N. BHARDWAJ.
Agra College, Agra,      I. M. RAO.
*March* 7, 1954.

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## GREEN PYRALID CATERPILLAR AS A NEW BORER PEST OF RATOON JOWAR

THE author, during his survey of jowar pests from 1947 to 1951, has recorded the following five types of borers attacking the jowar stems in the Bombay Karnatak : Stem fly (*Atherigona indica* M.), Stem-borer (*Chilo zonellus* S.), Pink borer (*Sasamia inferens* W.), White borer (*Diatrœa* Sp.), Green borer (*Anerastia oblutella*, Z.).

The green pyralid caterpillar was observed for the first time on ratoon jowar stems in the Dharwar Agricultural College Farm in April 1952. The damage caused was very severe. 1,188 stems were examined, out of which 605 stems showed "dead hearts". Out of these, 455 contained this caterpillar. The percentage of incidence works out to be 38·3 per cent. Since this borer is similar to the one described previously[1,2,4] in respect of colour, spiracles, hooklets on the pro-legs and head capsule, it is tentatively identified as *Anerastia* (*Raphimetopus*) *oblutella*, Zell (sub-family *Anerastilinœ* : family *pyralidœ*).

The caterpillar was found boring at the base of the newly formed stems of the ratoon jowar, either near the surface of the soil or just below it, incidentally producing the same nature of damage as the other borers, *i.e.*, showing dead hearts.

Detailed morphological, life and seasonal history studies under local conditions are in progress. It has been previously recorded by Mackenzie[2] on sugarcane in Bihar, on Nagarmotha grass (*Cyperus rotundus*) in the Central Provinces by Fletcher and Ratiram[3] and by Fletcher and Ghosh[4] at Pusa causing dead hearts in young sugarcane.

Dept. of Entomology, S. S. KATAGIHALLIMATH.
College of Agriculture,
Dharwar, *June* 8, 1954.

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## MALFORMATION OF PANICLES IN MANGO INCITED BY A SPECIES OF *ERIOPHYES*

A POTENTIALLY serious disease of mango (*Mangifera indica* L.) affecting the inflorescence has been observed in Poona. The inflorescence is completely malformed into green witches' broom-like structures and bears small leafy outgrowths in place of normal flowers. The disease appears to be well established in Poona, and as many as 400 trees that were examined in the precincts of the city area were found to have this type of infection. Other areas have not yet been surveyed for the prevalence of the disease. In some of the trees all the inflorescences of the current season appeared to have been affected and in others only a few inflorescences were diseased. Various reasons for this type of malformation appear to have been adduced, including the possibility of virus infection. Mundkur in his "Fungi and Plant Disease" illustrated the witches' broom malformation of mango inflorescence and suggested in a general way that "both hypertrophy and atrophy may be responsible for such development".

The diseased panicle shows its characteristic symptom even from the early stages. The peduncle becomes thick, green and fleshy and branches profusely (Fig. 1). Numerous small leafy structures crowded together (Fig. 2) are borne, and the whole structure presents a witches' broom appearance. Each group of leafy

structures represents a single malformed floret of the inflorescence. No fertile flowers are ever borne on these diseased panicles.



FIGS. 1 and 2

FIG. 1. Photograph of the malformed inflorescence.
FIG. 2. Enlarged view of the malformed florets.

Microscopic examination of sectioned material of the diseased panicles and florets has shown that the disease-inciting organism is a species of *Eriophyes* which are known to produce various types of galls and woolly excrescences on plants. In the case of diseased mango inflorescence, the mites are present in great numbers in the meristematic regions and tender portions of the peduncle. Within the host tissue numerous lacunæ are produced, and in these, all the stages of the developing mite may be observed. The anatomy of the cortex and stele of the inflorescence is considerably transformed accompanied by the development of hyperplastic cells. The *Eriophyes* species under study has been observed to produce disease symptoms only on the inflorescence. Similar floral abnormalities have been reported on various hosts in other countries. *Eriophyes malphigianus* Can. & Mass. has been reported to cause floral hypertrophy in *Laurus nobilis*.[1]

From a survey of the percentage of infection and distribution, the disease appears to be a potential danger to mango crop. Some of the dried inflorescences of the previous year's

infections, were found to contain living mites. *Oidium mangiferœ* Berth. which causes damage to tender leaves during the growing season, is noticed to develop profusely later on the malformed inflorescences, produced by the infection of *Eriophyes* sp. In the absence of any data on the use of acaricides and particularly the systemic insecticides for controlling the disease, prompt removal and burning of the diseased inflorescences should be taken up immediately.

For the facilities afforded to carry on this investigation in M.A.C.S. Laboratory, Poona, the author is indebted to Prof. S. P. Agharkar.

Poona,  M. J. NARASIMHAN.
*June* 20, 1954.

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# PRODUCTION OF FRUCTIFICATIONS OF *MARASMIUS CAMPANELLA* HOLTERM. IN CULTURE

WHILE investigating the decays of standing trees of *Lagerstrœmia speciosa* (L.) Pers. caused by *Marasmius campanella* Holterm., the authors experienced great difficulty in obtaining typical fructifications from the isolates of the organism from the rotted areas and also from the spore-cultures of *Marasmius campanella* growing luxuriantly over the trunks and branches of the affected trees. However, typical fructifications could be subsequently obtained by various trials and a brief account of the same is given below.

Like many other Basidiomycetes, the isolates as well as the spore-cultures of *Marasmius campanella* remained sterile in culture tubes containing such media as potato-dextrose agar, malt agar, wood-decoction agar, etc., under normal conditions of temperature, humidity and light of the laboratory. Eventually, the accelerator and also the methods for developing fructifications as recommended by Badcock[1,2] were tried. Dry saw-dust of sound sapwood of *Lagerstrœmia speciosa* was mixed with Badcock's 'accelerator' in various proportions (5-40 per cent. by weight). The mixtures were then soaked and put in Petri-dishes and in test-tubes. After sterilization, the media were inoculated with the isolates and also with the monosporous and polysporous cultures of the fungus in question already made available for the purpose. The cultures were then kept in darkness and at a constant temperature of 30° C. In all cases the growth started with much rapidity and produced white, luxuriant mycelial growth on this medium particularly

on those containing 30-40 per cent. by weight of the 'accelerator'. In none of the cultures did even the rudiments of fructifications appear within 1½ months from the date of inoculation. At this stage various devices were tried by placing them in an atmosphere of relatively high humidity. Some of the cultures of the isolates in Petri-dishes were kept in diffused light and room temperature (28-29° C.) of the laboratory with their lids open under bell-jars lined inside with moist blotting-paper. In the medium containing 5 per cent. 'accelerator', roundish, white mycelial knots appeared at the edge of the Petri-dishes within next 48 hours. These knots elongated considerably on the following day and gradually formed two well-developed centrally stipitate fructifications within 4-6 days from the date of exposure (Fig. 1, A & B). Several such fructifications
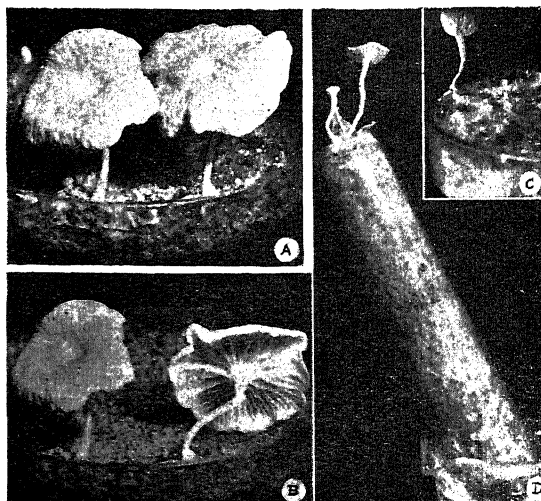


FIG. 1. Typical Fructification of *Marasmius campanella* formed in Culture (size reduced).

were also obtained in other Petri-dishes from monosporous cultures (Fig. 1, C). It was noticed that the media containing higher percentage of the 'accelerator' (20-40 per cent.) favoured vegetative growth, as such fructifications did not appear on them even when kept under identical conditions. Successful production of fructifications in this way induced the writers to expose similar cultures on potato-dextrose agar and malt agar media in Petri-dishes within moist bell-jars under identical conditions. Although there was the risk of contamination, this method also proved to be successful. Fructifications appeared on these media at the rim of the Petri-dishes within 48 hours from the time of exposure. This fact

indicates that cultures well supplied with suitable amount of food can be induced to produce normal fructifications of *Marasmius campanella* under the combined influence of high humidity (90-100 per cent.), aeration, temperature (28-30° C.) and possibly diffused light. It also points out that Badcock's medium is not an essential factor for this purpose.

In order to obtain fructifications from spore-cultures in test-tubes, a new method was devised. When the mycelium completely filled the saw-dust medium in culture tubes and became compact, a small opening was made at the base of each tube by carefully breaking the glass. Its plug was replaced by a sterile absorbent cotton plug which was pushed inside the tube in such a way that it came in contact with the medium while the other end of the plug slightly projected outside the rim of the culture tube. The tube was then placed in an inverted position in a beaker containing distilled water so that by capillary action through the cotton-plug a constant supply of water to the medium was maintained. The whole apparatus was kept within a moist bell-jar under the conditions already mentioned. It was only in the tubes containing 5 per cent. 'accelerator' the mycelium grew out at the broken end of the tube at first forming a cottony and fluffy growth within 5-6 days after exposure. Mycelial knots began to appear on the 8th day and within the next 24 hours fully developed fructifications were obtained (Fig. 1, D). In other cases several knots began to elongate simultaneously but only one of them soon took the lead to form a normal fructification while others became abortive. The fructifications copiously discharged spores on the surface of the culture tubes for several days.

The size of the fructifications varied considerably. The diameter of the pileus was 12-20 mm. and the stipe was 10-20 mm. long. In the majority of cases the fructifications were centrally stipitate. In all cases sections of the gills showed well-developed hymenia with normal disterigmatic and bisporous basidia agreeing closely with the measurements of those obtained in nature.

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Calcutta-19, *April* 21, 1954.

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## CONTRIBUTIONS TO THE FLORAL MORPHOLOGY OF *TERMINALIA CHEBULA* RETZ.

*Terminalia chebula* belongs to the family Combretaceæ. The present note deals with certain aspects of the floral morphology of this species.
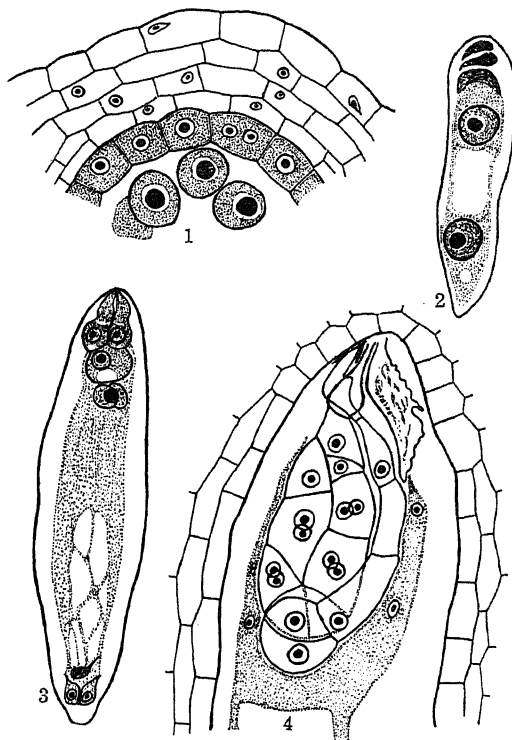


FIGS. 1–4.

FIG. 1. Anther lobe showing the epidermis, middle layers and tapetum, × 287.
FIG. 2. Two-nucleate megagametophyte, degenerating megaspores still persisting, × 287.
FIG. 3. Mature megagametophyte, × 72.
FIG. 4. Two embryos in a single embryo sac, × 72.

The wall of the anther consists of four or five layers of cells in addition to the epidermis; the innermost of these forms a secretory tapetum (Fig. 1). The mature pollen grains are binucleate.

The ovary is inferior, unilocular and contains usually two ovules which are bitegmic, crassinucellate and anatropous. Only one of the ovules develops into a seed; the rest degenerate and are crushed by the developing seed. Megasporogenesis proceeds normally and the development of the megagametophyte corresponds to Polygonum Type. The synergids show a filiform apparatus. The antipodals degenerate early (Figs. 2, 3).

Endosperm is nuclear and the first division of the primary endosperm nucleus takes place

before that of the oospore. Endosperm is completely consumed by the growing embryo.

Usually only one embryo is developed in each ovule. In a single case, however, two embryos have been found in the same embryo sac. One of the embryos is normal and therefore is developed from the fertilized egg. The other is found near it. Judging from its position this extra embryo seems to have been developed from one of the synergids (Fig. 4). A case of polyembryony has been reported by Venkateswarlu[1] in *Poivrea coccinea* DC., (*Combretum coccineum* Lamk.) a member of Combretaceæ, where the extra embryo seems to have been formed from a nucellar cell.

My sincere thanks are due to Dr. L. N. Rao for his kind interest during the course of this work.

Dept. of Botany,   M. NAGARAJ.
Central College, Bangalore,
*August* 10, 1954.

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## DNA CONTENT IN FEMALE GAMETOPHYTE AND NUCELLUS OF *TRADESCANTIA PALUDOSA*

THE original theory of Boivin, Vendrely and Vendrely[1] that the amount of DNA (Desoxyribonucleic Acid) per chromosome set of a species is approximately constant has obtained considerable support from later studies, notably those of Vendrely and Vendrely,[2] Mirsky and Ris,[3] Ris and Mirsky,[4] and more recently by Swift.[5] There has however been some disagreement from these views, more especially presented by Lison and Pasteels[6] who failed to find any constancy of DNA in tissue nuclei of a species or any correspondence between amount of DNA and degree of ploidy.

While a considerable amount of work on the quantitative estimation of DNA has been done on animal tissues, nearly the same attention has not been directed to the analysis of plant nuclei. And the little that has been done presents conflicting evidence in regard to the constancy of DNA in the different tissues of the plants examined. For instance, Schrader and Leuchtenberger[7] found no constancy in the amount of DNA in the different tissues of *Tradescantia* while extensive observations of Swift[5] in this plant indicated the presence of three or even four different values, depending perhaps on the degree of ploidy in the nuclei of the tissues examined. Bryan's[8] studies

showed no regular ratios. On the other hand, biochemical analysis by Ogur *et al.*[9] of different yeast strains showed a regular correspondence between DNA amount and degree of its ploidy.

A photometric analysis was made of the DNA content of the nuclei of the female gametophyte and the surrounding nucellus of *Tradescantia paludosa*. The mature gametophyte which is 8-nucleate and haploid is surrounded by nucellar cells whose nuclei are diploid, and it was felt an analysis of these should be useful in determining the relationship between ploidy and DNA amount. The measurements were made of Feulgen stained nuclei in Dr. H. Swift's laboratory, University of Chicago, Ill., U.S.A. The photometric apparatus is described by Swift.[5] The data obtained are given in Table I, which represent the mean of 18 measurements.

TABLE I

| | Gametophyte (*n*) | Nucellus (*2n*) |
|---|---|---|
| Diameter of nucleus ($\mu$) .. | 5·7 | 5·9 |
| Volume of nucleus ($\mu^3$) .. | 96·94 | 107·5 |
| Extinction (E) .. | 0·400 | 0·791 |
| Relative amount (E$\pi r^2$) .. | 23·7 | 47·8 |
| Relative concentration (E/$\frac{4}{3}r$) .. | 0·105 | 0·211 |

It will be seen that a very striking correspondence between the degree of ploidy and DNA amount exists in the tissues examined.

My sincere thanks are due to Dr. H. Swift for his kind interest and helpful suggestions.

Dept. of Botany,   M. NAGARAJ.
Central College,
Bangalore, *July* 28, 1954.

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## BACTRONOPHORUS THORACITES (GOULD) AS A PEST OF LIVING TREES IN THE SUNDARBANS, BENGAL (MOLLUSCA: TEREDINIDÆ)

THE marine borer *Bactronophorus thoracites* (Gould) (Mollusca, Eulamellibranchiata, family Teredinidæ), is an Indo-Australian species which has hitherto been recorded from Burma by Gould[1] and from the Dutch Colonies in the Indian Ocean (modern Indonesia) by Gray[2] as boring the timber of jetties and wharves in harbours ; there is so far no record from India.

During a survey of the 24-Parganas Forest Division in the Sundarbans, Lower Bengal, in January 1954, I found this borer doing serious damage to several species of *living* trees in the forests of the Kankramari and Lothian Islands, and it probably occurs all along the coastal regions of the Sundarbans which are subject to submergence under sea-water during the spring tides. This is the first record of *B. thoracites* from India and also probably the first record of a Molluscan marine borer doing damage to living trees.

The affected trees are found to be riddled with vertical galleries in the lower portion of the trunk, the galleries also extending into the tap-root for some distance. A medium-sized tree (about 25' high and 1' girth at 4½' height) may contain as many as ten live borers. As a result of the boring, the tree gets weakened and topples over in a strong gust of wind. A large proportion of the forest trees near the coastal region showed the attack.

A fuller account will be published elsewhere.

Forest Res. Inst.,      M. L. ROONWAL.
Dehra Dun, *June* 28, 1954.

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## DIE-BACK OF CHILLIE (*CAPSICUM ANNUUM* L.) CAUSED BY *ALTERNARIA* SP.

A MONTH-AND-A-HALF after transplantation the chillie crop on our farm showed scorching of the tips of the branches which extended downwards blackening stems and leaves and subsequently killing them. Although the symptoms were similar to those of "Die-back on chillies" described by Dastur[1] the acervuli of the causal organism, *viz.*, *Colletotrichum* was not found to be associated with the present disease. Some of the mildly infected leaves were found to develop black spots with concentric rings. Microscopic examination of the scraping of the spots on leaves revealed the presence of *Alter-*

*naria* spores. Platings of surface sterilized (mercuric chloride 1 : 1,000) infected leaves of chillies on potato-dextrose-agar medium yielded pure culture of *Alternaria* sp. Single spore culture of this fungus was made and spore suspension of the same in sterile water was sprayed with the aid of an atomiser on injured and uninjured chillie plants grown in pots under laboratory conditions (day temperature 104-08° F.). The injury was effected by pricking the tips of the branches with needle. Plants similarly injured but sprayed with sterile water served as control. The plants of the injured series took infection 3 days after inoculation, blackening of stems progressed rather rapidly and the plants completely withered on the tenth day. The uninjured series on the other hand manifested symptoms 28 days after spray and the plants withered gradually. The controls, however, remained healthy. The organism was recovered from the artificially infected plants on plating after surface sterilization, thereby confirming that the causal organism was *Alternaria* sp. Studies on morphology, physiology and pathogenicity of the fungus on other host plants are now in progress.

Biology Dept.,      J. C. EDWARDS.
Agric. Inst., Allahabad,    R. N. SHRIVASTAVA.
*May* 15, 1954.

1. Dastur, J. *Mem. Dept. Agric. India*, 1921, **11**, 129.

## GALACTOGEN IN SOME COMMON SOUTH INDIAN GASTROPODS WITH SPECIAL REFERENCE TO *PILA*

THE present note deals with the occurrence of galactogen in the reproductive system of a few common South Indian Gastropods. For the extraction of galactogen the method given by Baldwin and Bell[1] was followed. Galactogen was detected by hydrolysing it to galactose and testing the galactose by the osazone test, phloroglucinol test and mucic acid test. The materials used for the present investigations were the uterine portion of the reproductive system of *Pila* and the albumen gland in the case of *Viviparus* and *Ariophanta*. In the case of eggs, the albuminous fluid as a whole was used for analysis.

The uterus of fully mature specimens of *Pila* was employed for the quantitative extraction of galactogen. It was observed that about 28 per cent. of the dry weight of the uterine tissue was galactogen. The developing stages of the uterus taken from juvenile animals also contain a certain amount of galactogen. As the size of the uterus increases, the galactogen content also increases. In the earliest stages exa-

TABLE I

| Substance | Active life | | Aestivation period in months | | | | | | |
| | Sexually active period | Well-fed animal before æstivation | 1 | 2 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| Galactogen (grams per 100 g. of uterus) | 28·5 | 24·5 | 24·5 | 24·5 | 24·6 | 24·2 | 20·0 | 16·2 | 13·6 |
| Glycogen (grams per 100 g. of foot) | 1·9 | 10·1 | 9·7 | 9·3 | 7·2 | 5·6 | 5·5 | 5·2 | 5·2 |

mined by me, the galactogen content was about 7·4 per cent. of the total dry weight of the uterus. In later stages it gradually increases, reaching a maximum of about 28 per cent. found during breeding period.

It was observed that there is a sudden decline in the galactogen content after oviposition, though there was no complete depletion, the galactogen content falling to 14-15 per cent. Within a few weeks after egg-laying, the galactogen content was found to increase again, and to reach a value of about 24-25 per cent. before æstivation.

In *Viviparus*, the albumin gland in the reproductive system contained about 30 per cent. by dry weight of galactogen. In *Ariophanta* the albumin gland contained a slightly higher percentage of galactogen. The albuminous fluid of the eggs of *Pila* was also found to contain a good amount of galactogen.

The food of the adult *Pila* consisting of aquatic plants like *Vallisnaria* was analysed, but no trace of galactogen or galactose was found. It is evident, therefore, that the animal does not get its supply of galactogen as such in its food and that the presence of a large quantity of this polysaccharide in the animal implies that it is synthesised in the tissues of the animal from a monosaccharide like glucose which is available normally in the animal by the digestion of starchy food.

The galactogen content of the uterus and the glycogen content of the foot (glycogen is present in the foot only) in the different states of activity of the animal have been studied. The results are shown in Table I.

During the reproductive period the glycogen content of the animal is very low being about 2 per cent. of the dry weight of the foot. Later, after the reproductive period, it rises to about 10 per cent. During prolonged æstivation the galactogen content of the uterus declines. The portion of the uterus which is normally swollen becomes much shrunken and the relative weight of the uterus itself decreases as also the galactogen content. The glycogen content of the animal during this period shows an interest-

ing feature. Before æstivation it is high and after declining to some extent shows little fluctuation over a long period. This quantity which is about 5 per cent. is much higher than that present during the breeding season. It is reasonable to assume that the constancy of the glycogen which is the most important source of energy for the animal and the decline of galactogen are related, glycogen level being maintained probably by conversion of galactogen, as its derivation from food during æstivation is out of question. The great increase of galactogen to 28 per cent. and the marked decrease of glycogen to about 2 per cent. during the reproduction period would also point to the conclusion that there is probably interconversion of galactogen (or galactose) to glycogen (or glucose) and *vice versa,* according to the needs of the animal. Further work is in progress.

My thanks are due to Prof. R. V. Seshaiya for guidance.

Dept. of Zoology,       (MISS) V. R. MEENAKSHI.
Annamalai University,
Annamalainagar, *April* 24, 1954.

1. Baldwin, E. and Bell, D. J., *J. Chem. Soc.*, 1938, 1461.

## ON THE "SENSORY EPIDERMIS" OF STIPULES OF *VITIS REPENS* W. AND A.

WHILE studying the development and histogenesis of the tendril and stipule of *Vitis repens,* a striking histological feature of the abaxial epidermis of the 5th, 6th and subsequent pairs of stipules was noticed. It indicated that these, specially the 5th to the 7th pairs from the shoot apex, probably act as the organs of perception of mechanical stimuli, directing the plant in climbing round the support.

The growing tip of the shoot of *Vitis repens* appears ear-shaped. It usually consists of 5-7 pairs of stipules which remain folded together with 5-7 developing leaves and tendrils. The stipules are not persistent. Fig. 1 is a diagram of a stipule near the apex. The letter *a* indicates the region of attachment of the stipule with the node. The part of the stipule below

*a* consists of two auricular lobes which partly envelop the internode on the sides.

Longitudinal corrugated thickenings are observed on the outer wall of the abaxial epidermis of the 6th and subsequent pairs of stipules (Fig. 4). On the 5th pair of stipules, they were observed only on the cells near the margin. In cross-section they appear teeth-like. The adaxial epidermis is without such thickenings (Fig. 3), except a single row form-
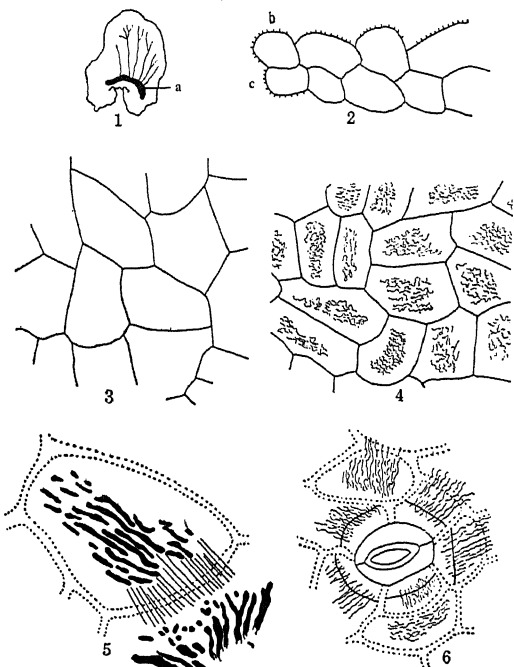


FIG. 1. A typical stipule, × 2. The region in black indicates the position of its attachment to the node.

FIG. 2. Cross-section of the 6th stipule near the margin, × 500. *b* and *c* denote abaxial and adaxial surface respectively.

FIGS. 3 and 4. Surface view of adaxial and abaxial epidermis respectively, × 220.

FIG. 5. Portion of Fig. 4 magnified, × 567.

FIG. 6. Surface view of abaxial epidermis with a stoma, × 300.

ing the edge of the stipule (Fig. 2). It is significant that the outer wall of the abaxial epidermis bulges out with the characteristic thickenings very prominently developed only in its central part (Figs. 2 and 5). They are absent or poorly developed in the auricular portion of the stipule. Even the subsidiary cells of the stomata (Fig. 6) show similar thickenings which also occur on the epidermis of the tendrils. Haberlandt[1] (pp. 572 and 577) describes this as "sensory epithelium" or "sensory epidermis". Goebel[2] has referred to the protective and assimilative function of the stipules. The histological features of the abaxial epidermis indicate that in *Vitis repens*

the stipules, specially 5th-7th pairs, probably perform the function of perception of the external mechanical stimuli.

I offer my grateful thanks to Prof. P. Maheshwari for his help and encouragement and to Shri I. N. Solanky for facilities.

Dept. of Biology,                    J. J. SHAH.
M.T.B. College, Surat, *June* 1, 1954.

1. Haberlandt. G., *Physiological Plant Anatomy*, 1914, Macmillan & Co., Ltd., London.
2. Goebel, K., *Organography of Plants*, Part 2, 1905, Oxford Clarendon Press.

## VENTRICULAR GLANDS OF *GRYLLO-TALPA AFRICANA* BEAUVOIS (GRYLLIDAE: ORTHOPTERA)

IT has been recorded that in Gryllidæ, the cardia of the ventriculus has a pair of gastric cæca. In *G. africana* besides a pair of gastric cæca there are present two pairs of branched gland-like structures. These structures are situated between the gastric cæca on the cardia of the ventriculus and are gland-like, and therefore, they are being called as *ventricular glands*. Sayce[1] studied the structure of the alimentary canal of *G. australis* in detail, but he has not mentioned about these glands at all. In fact the presence of the ventricular glands has not been recorded in any other insect.

Each gland (Fig. 1) is branched, tree-like and consists of a large number of tubes. Each
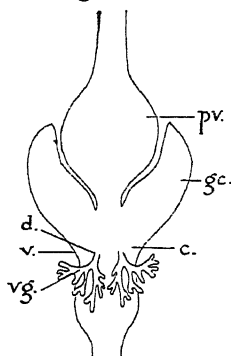


FIG. 1. *c.*, Cardia ; *d.*, duct of the ventricular gland; *g.*, gastric cæcum ; *pv.*, proventriculus ; *v.*, ventriculus ; *vg.*, ventricular gland.

tube is branched, each branch ends blindly and becomes swollen at its blind end. Each gland opens separately into the cardia through its duct. All the four glands may not be of the same size, *i.e.*, some may have a large number of branches while others may have only a few. Each gland is about 3·0 mm. long.

Dept. of Zoology,                    R. RAKSHPAL.
The University, Lucknow, *May* 12, 1954.

1. Sayce, O. A., *Proc. Roy. Soc. Victoria*, 1899, **11**, 113.

# REVIEWS

**Signal Noise and Resolution in Nuclear Counter Amplifiers.** By A. B. Gillespie. (Atomic Energy Establishment, Harwell.) (Pergamon Press, Ltd., London.) Pp. 155. Price 21 *sh.*

This monograph deals with an important aspect of the technique of electronic counting of nuclear radiations. Randomly spaced pulses of about a few microvolts to some millivolts, depending on the initial ionising event, are obtained from nuclear detectors such as the ion chamber and proportional counter. These pulses have to be amplified to a level of about 30-40 volts for amplitude discrimination and recording. The time constants, signal to noise ratio, resolution and sensitivity of such amplifiers form the subject-matter of this book.

Chapters 1 and 2 are largely introductory, while the different types of noise are dealt with in Chapter 3. Their magnitudes in some of the special valves, used in the amplified input stage, are discussed, and these data are bound to be of help in the design and use of such equipment.

The next chapter discusses signal to noise ratio and its dependence on amplifier constants. The author has illustrated how this ratio and resolution are opposing factors; one can only speak of the 'best value' with respect to a particular resolution. Pulse shaping and its usefulness are next discussed and the delay line and ringing coil techniques of shaping are analysed.

Chapter 5 is devoted to a discussion of the sensitivity in energy and activity measurements with typical examples. Results are quoted, showing good agreement between measured and calculated values. This and the previous two chapters present valuable experimental data and the original methods of analysis by the author, which form an outstanding contribution to the subject. The last chapter deals with proportional and scintillation counters, with a very useful discussion on the 'pile up' of unwanted pulses.

A noteworthy feature of the book is the lucidity of the text. Every topic is clearly introduced before the detailed discussion that follows. The mathematical portions have been properly relegated to the appendix so that it is easy to follow the physical basis. Even so, some of the integrations done in the appendices could have been left out; instead, an elaboration of the last chapter and perhaps some additional details of noise measurements would have been welcome.

This, however, is a very minor point about the monograph which is an extremely useful and timely publication. The volume has a definite place in any laboratory where quantitative experiments are being made with counters and amplifiers.

K. S. Chandrasekaran.

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**The Standing Wave or Hydraulic Jump.** Second Edition. Revised and Enlarged. Publication No. 7 of the Central Board of Irrigation and Power, 1950. Pp. x + 146. Price not given.

A hydraulic jump is an abrupt lift in the surface of a stream at a stationary section, due to one or other of a variety of causes. The surface at the jump is constantly falling in a turbulent manner against the on-coming stream and, as such, can be considered as a wave which moves up at that place, with a velocity equal to that of the stream, so that it is left "standing".

These standing waves are mainly used to dissipate the kinetic energy of flow, in order to avoid undesirable effects like under-cutting of foundations due to scour action. They are therefore widely utilised at the rear of dams and weirs and below regulators, sluice gates, drops, etc.

The book under review is a revised and enlarged edition of an earlier publication issued in 1934, written by A. M. R. Montague. In the present edition, issued by the Central Board of Irrigation and Power on 15th August 1950, the subject has been brought uptodate and a number of new chapters have been included. The draft of this new edition was prepared by Dr. N. N. Bhandari, then Assistant Secretary of the Central Board of Irrigation and Power, and scrutinised by an authoritative Committee of top-ranking workers in the field, within the country. A very useful and fairly complete bibliography is also appended.

Though the publication is mainly intended as a handbook for use by the engineers and research officers in the different hydraulic laboratories within the country, it will be found equally valuable by all students of hydrodynamics in general. T. N. Seshadri.

**Planetary Tables**, Vol. I. (*Tables of Mercury.*)
By Harihar P. Bhatt. (Gujarat Vidya Sabha,
Ahmedabad), 1953. Pp. viii + 20 + 18. Price
Rs. 2.

This book of tables helps one easily to com-
pute with sufficient accuracy the position of
the planet Mercury at any time. The best
source available for the purpose is no doubt
Prof. Newcomb's, which is not easily avail-
able now.

The heliocentric co-ordinates of Mercury are
given with the necessary formulæ and refer-
ences for conversion to geocentric co-ordinates
and apparent R.A. and declination. The rela-
tivity correction is however omitted, which is
rather a minute quantity, though appreciable
in the case of mercury.

Though these tables do not enable one to
calculate the planetary position as accurately
as Newcomb's tables, they are easier for com-
putation and the maximum error in the observ-
ed time of transit is only 0·7 of a second of
time, and that in the geocentric latitude is only
a second of arc. For the computation of the
different almanacs in the Indian States and
observers, these tables are accurate enough and
simpler in manipulation than many other pub-
lished in India and outside.

This book is very useful and handy to alma-
nac computations, and the author deserves to
be congratulated on bringing out such a cre-
ditable work.

H. Subramoni Iyer.

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**Primates—Comparative Anatomy and Taxo-
nomy.** Vol. I. *Strepsishini* (*lemurs, loriscs
and galagoes.*) By W. C. Osman Hill. (Edin-
burgh University Press), 1953. Pp. xxiii +
798. Price £ 5 *sh.* 5 net.

In the forty years that have elapsed since
the publication of the last monograph of Pri-
mates by Elliot, a considerable amount of
diverse information has accumulated on the
group. This cumulative knowledge has been
ably arranged and critically reviewed by
Osman Hill in the volume under review. He
has introduced freshness in the subject by
bringing in new data and reassessing the older
ones.

The most outstanding feature of the work is
its thoroughness, there being hardly any aspect
that has been left out. One may not agree
with the qualifying expression "Comparative
Anatomy and Taxonomy" to the title of the
book; "Primates" alone would have done.
The ultimate aim of a systematist is to arrive
at a natural classification, to achieve which he

needs to consider not only the external and
internal morphlogy of the animal, but also its
biology. This has been pre-eminently fulfilled
by Osman Hill and his work may indeed serve
as a model.

This volume begins with a short general in-
troduction to the Primates. It includes a pithy
discussion of the definition of the order and of
its external characters, skeleton, dentition,
brain and sense organs, reproduction, placenta-
tion, distribution, taxonomy, phylogeny, etc.
Perhaps many will welcome the author's deci-
sion to exclude the Tupaiids (tree shrews)
from the Primates, not because their affinities
are denied, but because it is generally consi-
dered undesirable to cause violent changes in
the older classification by shifting such border-
line forms from one group to the other, and
thereby giving a new conception to the groups.
Regarding the grouping of *Tarsius* with the
higher Primates, a comparative anatomist can
speak with authority ; but the step has per-
haps been taken in the right direction by rele-
gating this curious creature to a subordinal
rank. The older subordinal name Anthropoidea
is replaced by Pithecoidea by Osman Hill,
probably because it is a more expressive term.
In the outline classification on page 25, we
note that contrary to the latest classification
proposed by Simpson, the families of Pithe-
coidea have not been grouped into any cate-
gory between the suborder and the family.
This would seem to make the classification sim-
pler no doubt, but it is hoped that the second
volume, which will deal with this suborder,
will clarify the procedure adopted here.

The account of Strepsirhini forms the bulk
of the book. It is divided into two suborders,
Lorisoidea and Lemuroidea. Two families are
included under the former, and eight under the
latter. Each of them has been critically dealt
with under such items as historical, external
characters, skeletal system, dentition, articula-
tory system, myology, splanchnology, angeio-
logy, neurology, reproduction, development,
behaviour, taxonomy, distribution, etc.

The treatment of the facts of morphology,
appears to be rather liberal, but this seems
inevitable in many cases owing to paucity of
information on topics other than morphology.
In the author's attempt to supply a detailed
description of each group, some unavoidable
repetition of facts have crept in. Diagnostic
keys have been provided up to species, but
they have been left out for subspecies; never-
theless, a perusal of the descriptions of sub-
species makes it at once evident that the author
has admirably brought out their respective

distinguishing characters. A key to the sub-species would have lent an additional feature to the book, but its absence has by no means minimized its usefulness. A further commendable feature of the book is the distribution maps.

An extensive and well-selected list of references, without titles of papers, marks another feature. This procedure was probably adopted by the author in order to accommodate the matter within a few pages. In the index the subspecies are arranged under the species, and the species under the genera, which are arranged alphabetically. This has made the consultation of the index somewhat more time-consuming. The traditional method of arranging all scientific names in a single alphabetic order would have facilitated the use of the index.

A few minor slips are casually noticed ; for example, in giving Simpson's outline classification on page 24, the superfamily Daubentonioidea has been overlooked; on page 318 the correct date for Schwarz's reference should be 1931; the length of the skull of *Lemur catta* as stated on page 391 appears to be an error ; and the colour of the back of the head of *Propithecus d. diadema* does not appear to have been correctly given (p. 519).

We can confidently say that it is a book which will satisfy all who are interested, and that by the publication of this book Osman Hill sets an example to be emulated by all those who are desirous of undertaking systematic reviews.

H. KHAJURIA.
B. BISWAS.

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**The Mind and the Eye.** (*A Study of the Biologist's Standpoint.*) By Agnes Arber. (Cambridge University Press), 1954. Pp. 146. Price 16 *sh.*

Mrs. Arber is a distinguished botanist and the author of that classic, *The Natural Philosophy of the Plant Form.* But here she turns from the usual preoccupations of a specialist, to face the broader issues which it is given only to some to ask themselves. As stated in the preface, the author found her mind "dwelling more and more upon the nature of scientific thought, and its relation to other intellectual activities. Such ponderings have led me gradually to realize how little I, as a biologist, could actually justify, or even, indeed, understand, the nature of the basic assumptions and modes of argument which, in accordance with scientific tradition, I was taking simply as 'given'".

These reflections are embodied in the course of ten essays, of which the first five are concerned with the nature of biological research and the rest with the basis of biological thinking. The essays reveal much philosophical erudition, as evidenced by the many references; also the author has taken great pains to explore the borderland between science and philosophy. Even specialists with no inclination to philosophy will find much practical wisdom in the two chapters on the use of analogy and the many imperfections of the written word for a description of the objective reality that concerns the scientist.

Some like the reviewer might have been led to expect a great deal more from a book with such a title, but the preface vindicates the author from any criticism on this score. As a more generalised analysis of the biologist's approach to his own subject and to philosophy, the volume is highly commendable : an excellent guide book, one is inclined to say, to any scientist who feels like making excursions occasionally into the realms of philosophy, for greater freedom and enjoyment.

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***Elsevier's* Encyclopaedia of Organic Chemistry.** Edited by F. Radt. Series III. Carbocyclic condensed compounds. Vol. 12 B. Naphthalene. A. Compounds containing one naphthalene nucleus. Naphthoic acids and their halogen, nitrogen and hydroxyl derivatives. (Elsevier Publishing Co.), 1953.    Pp. 3965-4560. Price £ 16 to subscribers.

The seventh part of Vol. 12 B deals with the naphthoic acids, their hydro-derivatives, homologues, halogen, nitrogen and hydroxyl derivatives. Lactones and lactams are treated in conjunction with the hydroxy- and aminocarboxylic acids. The general excellence, comprehensiveness and dependability of the earlier volumes of Elsevier have been maintained. Methods of preparation of the more important compounds are given in such detail that they can be repeated without reference to the original literature. *Elsevier* is now to be found in the library of every institution handling organic chemistry in any of its aspects ; and regular users of *Elsevier* look forward anxiously to the appearance of new volumes because they have found by experience that, if an *Elsevier* volume treats a group of compounds in which they are interested, hours of labour in hunting up literature will be saved. The gap between the date of publication of an *Elsevier* volume and of the material it records has been reduced to about four years. The policy, criticised by this

reviewer in reviewing earlier volumes, of omitting patent literature has now been abandoned.

The treatment of the naphthoic acids includes their physical properties, formation, preparation reactions and physiological properties. All the known derivatives are dealt with in detail. Hydroxynaphthoic acids and their derivatives, especially the technically important 2-hydroxy-3-naphthoic acid and its arylamides (Naphtol AS and its analogues), are treated very fully. No error or material omission was detected. Naturally occurring compounds receive particular attention, and there are excellent accounts of podophyllotoxin, picropodophyllin and related compounds, very recent literature being incorporated with the co-operation of Drs. Schrecker and Hartwell of the National Cancer Institute of the U.S.

K. V.

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**Metabolic Integrations.** By P. G. Watson. (W. Heffer & Sons., Cambridge), 1954. Pp. 12. Price 12 *sh.* 6 *d.*

This booklet on metabolic integrations consists mainly of charts illustrating the various metabolic reactions, and is primarily intended to give a coherent picture of the various energy-releasing biochemical reactions. In twelve pages are given a master chart of Krebs tricarboxylic acid cycle, Krebs ornithine cycle, and cytochrome systems as well as nine other charts showing the breakdown of nucleotides and nucleic acids, anaerobic metabolism of glycogen, starch, sugars, fats, amino acids and nitrogenous excretory products. While the main references are given at the end on the inside back cover, these charts by themselves should prove very useful to all students of biochemistry and physiology as summaries of various biochemical processes, and the author is to be congratulated on bringing out such a commendable publication. P. S. Sarma.

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**Imidazole and Its Derivatives,** Part I. By Klaus Hoffmann. (Interscience Publishers, Inc.), 1953. Pp. vii + 362. Price $ 8.00.

The volume under review is the sixth in the series of monographs edited by Dr. Weissberger on the chemistry of heterocyclic compounds and deals with imidazole and its derivatives. In Section 1 of the volume an accurate and comprehensive account of the chemistry of imidazole and its derivatives such as alkyl and aryl imidazoles, oxo- and hydroxyimidazoles, halogeno-, nitro-, amino- and arylazoimidazoles, and imidazole-carboxylic and sulphonic

acids is given. The chemistry of imidazolines, imidazolidines and benzimidazoles is also dealt with at great length. The discussions on the individual classes of imidazole derivatives and their physical properties and chemical reactions furnish excellent and stimulating reading. The book would be well worth study, not only by those interested in imidazole derivatives, but by all chemists engaged in the study of heterocyclic compounds.

In Section 2 of the book, a list of imidazole derivatives has been presented, the literature having been surveyed upto the end of 1950. A bibliography with over 700 references is appended to this list. The book is a most useful publication and should find a place in all libraries attached to institutions engaged in teaching of organic chemistry or research in this field. T. R. G.

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**A Historical Survey of Petrology.** By F. Y. Loewinson-Lessing. Translated from the Russian by S. I. Tomkeieff. (Oliver & Boyd, Edinburgh and London), 1954. Pp. 111. Price 12 *sh.* 6 *d.*

The volume under review is an excellent source-book for the history of petrography and petrogenesis. The translator does not regard this as a verbatim English translation of Loewinson-Lessing's book in Russian, but states that it is a free translation, with curtailments, amplifications and additions. The translation has thus enriched and made the original more uptodate. The book is written in six sections, five of which are devoted to the different points of approach to the subject of petrology, namely, the geological, the petrographic, the chemical, the experimental and the synthetic.

The history of petrology is divided into the pre-microscopic and the microscopic periods, the dividing line being probably the year 1870. The microscopic period is again subdivided into two stages, the first one being distinguished by intensive descriptive petrography (1870-90), and the second from 1890 onwards, by chemical petrology. In his geological approach, Loewinson-Lessing gives a historical account of the various petrologists who have studied rocks with reference to distribution in space and time. One of his distinguishing remarks is, "Another well-rooted opinion that all granites are ancient rocks, and in fact mainly of the Pre-Cambrian age, has been shattered by the discovery of granites of Palæozoic, Mesozoic and Kainozoic age".

The book recalls everything we know of rocks from the earliest days of the French petrolo-

gists like Cordier and Brougniart, to the present day of American experimentation in the Geophysical Laboratory, New York. No student of petrology should miss this book from his reference-collection.       P. R. J.

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**History of Indian Pharmacy, Vol. I. Second Edition.** By G. P. Srivastava. (Pindars, Ltd., Calcutta-20), 1954. Pp. 276. Price Rs. 12-8-0.

This book which claims to be a history of ancient and mediæval pharmacy in our country, was originally published in parts as series of articles in the *Indian Pharmacist*. A second volume which is promised by the author, will deal with modern Indian pharmacy.

The volume consists of ten chapters dealing with the origin of medicine or the healing art in India in the dim, hoary, legendary past—the beginnings shrouded in mythology and theology and nothing more authentic up to the middle ages of history.

The book is obviously the result of much labour, tinged with sentiments of national pride and perhaps idealism as well. Indian books that claim to belong to pre-Christian era, have often in them matters to provoke awe and admiration, but unfortunately the dates of these writings remain unproved. Even if they are proved to belong to a later era, such as early Christian period, there is still considerable material in them to command admiration and for careful observation, collection and experimenting.

This book therefore is one more 'Archæological find' to enhance the prestige of ancient India and this time in the field of pharmacy. The author deserves praise for his labours.
           V. Iswariah.

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**Handbook of Cosmetic Materials.** (*Their Properties, Uses and Toxic and Dermatologic Actions.*) (With a chapter on The Skin by Howard W. Haggard.) By Leon A. Greenberg and David Lester. (Interscience Publishers, Inc.), 1954. Pp. xii + 455. Price not given.

A continued search by the chemist for cosmetic aids for specific purposes has resulted in the use of several hundred synthetic chemical compounds. Whether the compounds being used are new or old, the cosmetic manufacturer must have a knowledge of their toxic and dermatologic properties. This awareness led the (U.S.) Toilet Goods Association "to request the members of the cosmetic industry to furnish lists of ingredients important to them with a view to the development of a basic **reference work**".

The present Handbook lists nearly 1,000 materials—those that are more commonly used by the cosmetic manufacturers. The staff of the Yale University Laboratory of Applied Physiology compiled all the available information on each compound or material included in the list. This information has been arranged under five headings : Formula (including collateral names), properties, uses, toxic action and dermatologic action. An important feature of the Handbook is the extensive bibliography of the literature on the toxic and dermatologic actions of the compounds. This would be of great assistance to both the cosmetic manufacturer and the research worker in that field.

It has been stated in the Foreword that the work of reviews and compilation took about four years, which indicates the care and effort that must have been bestowed upon it. The reviewer is not unmindful of these when the following comments are made : (1) There is lack of uniformity in giving the occurrence or the method of obtaining and the constituents of a material. These are sometimes given under 'Formula' and sometimes under 'Properties'. (2) Component fatty acids of some of the fatty oils have been incorrectly given, *e.g.*, oils of palm and linseed. Oil of cod liver is stated to contain butyl alcohol esters. Oil of peanut is stated to contain hypogæic acid—an obsolete term. (3) No uniformity has been observed in giving the constituents of essential and fixed oils. For some, percentage composition is given ; for others, only the components are mentioned or no mention of components is made at all (*e.g.*, oils of palmarosa and sesame). (4) Melting points of cocoa butter and of lauric, myristic and palmitic acids are incorrectly given. (5) The usefulness of such a Handbook would be greatly increased if an 'Index of Uses' were to be incorporated.

The chapter on "The Skin" forms an appropriate part of the Handbook. Members of the cosmetic and allied industries as well as chemists, physicians and dermatologists would find the Handbook highly useful.     J. G. Kane.

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**Optical Image Evaluation.** (Proceedings of the Symposium held October 18-20, 1951, NBS Circular 526.) (Order from Govt. Printing Office, Washington 25, D.C.), 1951. Pp. 289. Price $ 2.25.

The National Bureau of Standards, U.S.A., has been active in the field of optical image evaluation for many years. In the field of applied optics it has been usual to evaluate optical design by taking measurements of the system's geometric aberrations. This practice

is justified when the aberrations are so large that diffraction plays but a small part in determining the quality of imagery. Now, however, better optical systems are being produced. Automatic computers make it possible to completely test a design by computation. The interferometer enables the wave front emergent from an optical system to be completely mapped. Also, integrating devices can be used to readily and completely determine the diffraction effects. Accordingly it is now possible to evaluate an optical image forming system in terms of physical optics either when it has only progressed to the design stage or after a prototype is available.

As a consequence of these new developments it seemed desirable to re-examine the older methods of image evaluation as well as the newer procedures in order to place image evaluation upon a more sound engineering basis. For this purpose a symposium was held in which scientists from all parts of the world participated. The full papers of this symposium are presented in this book including the discussions.

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## Books Received

*Wool—Its Chemistry and Physics.* By P. Alexander and R. F. Hudson. (Chapman & Hall), 1954. Pp. viii + 404. Price 45 *sh.*

*Subminiaturization Techniques for Low-Frequency Receivers.* (NBS Circular 545), 1954. Pp. iv + 64. Price 50 cents.

*Text-Book of Metallurgy.* By A. R. Bailey. (Macmillan & Co.), 1954. Pp. viii + 560. Price 30 *sh.*

*Stainless Iron and Steel,* Vol. 2. Third Edition. Revised. (*Microstructure and Constitution.*) By J. H. G. Monypenny. (Chapman & Hall), 1954. Pp. xii + 830. Price 55 *sh.*

*Essays on the Social History of Science,* Vol. 3. Edited by S. Lilley Cenlaurus. (Ejnar Munksgaard, Copenhagen), 1953. Pp. 182. Price not given.

*Annual Review of Biochemistry,* Vol. 23. Edited by J. Murray Luck, Hubert S. Loring and Gordon Mackinney. (Annual Reviews, Inc.), 1954. Pp. ix + 636. Price $ 7.00.

*Technical Report of the Scientific Advisory Board for the Year* 1953. (Indian Council of Medical Research), 1954. Pp. xiii + 449. Price Re. 1.

*The Physical Chemistry of Dyeing.* By Thomas Vickerstaff. (Macmillan & Co.), 1954. Pp. viii + 514. Price 42 *sh.*

*Ion Transport Across Membranes.* Edited by H. T. Clarke and D. Nachmansohn. (Academic Press, Inc.), 1954. Pp. xi + 298. Price $ 7.50.

*Hydraulic Research in the United States.* Edited by H. K. Middleton. (NBS, Washington 25, D.C.), 1954. Pp. xii + 193. Price $ 1.25.

*Discovery Reports,* Vol. XXVI, Nos. 1-8. Issued by the National Institute of Oceanography. (Cambridge University Press), 1954. Pp. vi + 354. Price 99 *sh.*

*Micro-Element Nutrition of Plants.* By K. N. Lal and M. S. Subba Rao. (Banaras Hindu University Press, Banaras 5), 1954. Pp. viii + 246. Price Rs. 20.

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## PROTEINS IN HEALTH, DISEASE AND INDUSTRY

A SYMPOSIUM on the above subject was held in Bombay on 6th and 7th August 1954, under the auspices of the National Institute of Sciences of India, when several papers among the forty-four received, were read and discussed. Many of them stressed the need for the proper utilization of waste proteins like those from shark fish residues, and the preparation of portein hydrolysates from pulse proteins, fibrin and the like. Interesting discussion took place in regard to the degree of hydrolysis of proteins during acid and enzymic digestion and the destruction during hydrolysis of some essential amino acids. The use of formic acid along with the hydrochloric acid for a quick and efficient method of hydrolysis of tissue proteins was also discussed. The nutritive value of different proteins by such methods as bio-logical value determination using rats and by the maintenance of liver cytoplasm was also reported. Other interesting reports were the remarkable gowth-stimulating effect observed in growing heifers when small amounts of iodinated casein were added to their daily feed, and the study of the different factors such as buffer, temperature and catalyst in the iodination of different proteins. Papers relating to bacterial proteins and their prophylactice use, the mechanism of specific dynamic action of proteins, the reactivity of thiol groups in proteins and histamine-like substances in protein hydrolysates were also interesting, as well as the one relating to preservation of proteins particularly the processing of meat from fish of the carp variety.

P. S. SARMA.

# SCIENCE NOTES AND NEWS

## Insecticidal Resin

An effective method of insect control used in British cargo ships involves spraying infested surfaces with a lacquer containing the insecticide dieldrin. Such a lacquer is Ripolac. This sets in about 30 minutes giving a hard glassy surface with an insecticidal activity that is claimed to last for over 2 years. Microscopic crystals of the insecticide form on the hardened surface of the lacquer and stick to the feet of insects as they alight on it. The insecticide is so powerful (in some cases 200 times as toxic as D.D.T.) that even a few crystals picked up will eventually kill the insect. This means that momentary contact only is necessary. The lacquered surface can be washed repeatedly with detergent without losing insecticidal activity. Economical use of lacquer is appreciably assisted by a knowledge of the life-history of the pest. For example, cockroaches like dark, sheltered niches and for their destruction the lacquer should be applied to corners, cracks and the under-surfaces of furniture.

## Steroids for Chromatography

Through the co-operation between a number of fine chemical companies and university laboratories in the United States, steroid preparations for use as reference standards for paper chromatographic techniques are now available. This service has been undertaken by the United States Pharmacopeial Convention, 46, Park Avenue, New York-16, which has announced the issue of the first set of twenty-four steroids of importance for identification purposes. Many of these have hitherto been unobtainable from commercial sources. The price of the complete set is $ 60; but the individual steroids can be obtained for $ 3 each. They are diluted with talc in the proportion of 1 : 100, and from this mixture the steroid can be readily extracted with an appropriate solvent. Most of the steroids contain trace amounts of contaminants which will not normally interfere in chromatographic procedures. Physical data of the steroids are set out in an accompanying leaflet, which also provides information concerning the programme of the United States Pharmacopeia Service. It is proposed to issue further sets of steroids, and in due course a total of fifty-two steroid standards will be available to all parts of the world.—(*By courtesy of 'Nature'.*)

## Fresh-water from the Sea

A device for extracting fresh-water from sea-water by using the same purification principle as body tissue has been developed by Mr. Gerald Hassler, an engineer in the University of California.

Mr. Hassler's process involves the selective action of an osmotic oil membrane, the principle by which body organs and individual cells separate fluid constituents. Osmotic membranes have been proposed before in connection with sea-water distillation. However, previous membranes have been like sieves, with tiny holes which allow small molecules to pass through while rejectnig larger ones.

The Hassler membrane is an extremely thin layer of oil supported by capillary action. It has no holes as such, but water molecules can diffuse through it while other molecules are blocked. Mr. Hassler believes he can ultimately produce "a cubic yard" of oil membranes capable of producing 2,000 gallons of fresh-water per day. The unit would cost about $ 1,000 and last for 20 years.

## *Journal of the University Geological Society, Nagpur*

The inaugural number of the Journal which is being sponsored by the University Department of Geology, Nagpur, contains the following titles : 'A Tourmaline Pegmatite from Koradih, Central Provinces', by Sripadarao Kilpady ; 'A Giant Pelecypod from the Cretaceous Rocks of Trichinopoly', by Sripadarao Kilpady; ' A Note on a Green Calcite from the Deccan Traps', by Sripadarao Kilpady and P. G. Adyalkar ; 'Fossil Algæ as Criteria of Palæo-Ecological Conditions', by Sripadarao Kilpady ; 'Dumortierite from Garrah, Balaghat District (M.P.)', by Sripadarao Kilpady and A. S. Dave ; 'Newer Developments in the Search for Hidden Mineral Deposits' by Alan M. Bateman. The Journal conforms to the standards expected of one devoted to the publication of pure research. We extend to it our heartiest good wishes.

## Indian Association for the Cultivation of Science Report for 1953-54

The Annual General Meeting of the Indian Association for the Cultivation of Science was held on Friday, July 30, 1954. Prof. P. Ray, Acting Director, in presenting the Annual

Report stated that the research departments, the library, the workshop and the administrative office continued to function actively for the third year in the new research laboratory building at Jadavpur.

During the year under review, the Association had under operation four research schemes of the Council of Scientific and Industrial Research of the Government of India. A symposium on high polymers including rubber, resins and plastics and fibre was organized by the Department of Physical Chemistry of the Association.

The following officers were elected for the current year : *President* : Hon'ble Sri. C. R. Biswas ; *Vice-Presidents* : Prof. S. K. Mitra, Dr. K. S. Krishnan ; *Director* : Prof. M. N. Saha.

## World Census of Agriculture

The United Nations Food and Agriculture Organization hopes to complete, by the end of 1954, the first volume of a world census of agriculture. The work, which is the third such study ever to be undertaken, will cover agricultural statistics for 63·3 per cent. of the land surface of the globe and covers territories inhabited by 67·6 per cent. of the world's population.

The census will be published in three volumes: the first will summarize statistical methods used for the census ; the second will tabulate the data for each country ; and the third will make a comparison of each country's statistics and analyse, on a regional or worldwide basis, the principal elements such as utilization of land, tenure, agricultural workers, crops and stock-breeding.

The publication of the second and third volumes in 1955 and 1956 respectively will complete ten years' preparation, collation and analysis of facts supplied by over a hundred countries and territories.—*UNESCO.*

## Conference on Human Problems in Industry

A Commonwealth and Empire Conference on human problems in industry is to be held in Britain (probably at Oxford) during July 1956. The purpose of the Conference will be to bring together representatives from the Commonwealth and Empire who would pool their knowledge and experience of the human problems of industry in their own countries. It is intended that the age of the delegates should normally be between twenty-five and forty. The Conference will deal with the human factors in industrialization as a whole : on one hand

the personal factors of the health, satisfaction, effectiveness and well-being of those working in industry ; on the other, the social problems arising from the effects of industrialization on the lives of individuals, their families and communities. Further particulars can be obtained from the Industrial Welfare Society, 48, Bryanston Square, London, W.1.

## Electronics Course at Harwell

Applications are invited by the Atomic Energy Research Establishment, Harwell, from physicists and electronic engineers holding a Degree or equivalent qualification, who wish to attend the ninth electronics course. The course covers the design, use and maintenance of electronic instruments used in nuclear physics, radiochemistry, and in work with radio-isotopes. It is to be held at the Isotope School, Harwell, during November 1-5. Attendance at the course is limited to 12 students. The syllabus will include lectures and practical work concerned with counters, D.C. and pulse amplifiers, coincidence units, scalers and rate-meters. The lecturers and demonstrators will be specialists from the Atomic Energy Research Establishment. The fee for the course is 12 guineas, and living accommodation can be arranged locally at a charge of 5 guineas approximately. Further information can be obtained from the Electronics Division, A.E.R.E., Harwell, Didcot, Berks. Application forms must be returned by October 15.

## Burmah-Shell Scholarships

The Council of Scientific and Industrial Research have awarded the Burmah-Shell and Assam Oil Co. Scholarships tenable in Commonwealth countries to the following for scientific research and technical training in the subjects noted against their names:

*Burmah-Shell Scholarships.*—R. Nagarajan (New Delhi): Highway Engineering ; Krishna Chandra Pant (Lucknow): Electro-Chemistry; and Nareshchandra Majumdar (New Delhi): Power Engineering.

*Assam Oil Company.*—B. V. Ranganatham (Madras): Avoidance of Foundation Failure ; Rajinder Paul Khera (Bhavnagar): Corrosion and Wear ; R. Narayanaswami (Bombay): Prestressed Concrete ; P. S. Ram Mohan Rao (New Delhi): Structural Designs ; A. Kameswara Rao (New Delhi): Aviation Engineering; K. B. Narain (Delhi): Designs and Construction of Transformers Rotary Convertors. Electric Generators, etc.; Daleep Singh Deorha (Meerut): Chemo-Therapy.

## UNESCO Travel Coupons

In March 1954, UNESCO launched its Travel Coupon Scheme, which enables students, teachers and research workers to obtain foreign currency to study abroad. They constitute the latest addition to the series of UNESCO Coupons which overcome cultural barriers. In 1948, the Book Coupon Scheme was started with only 5 countries and a 'hard-currency' backing of $ 100,000. Now 33 countries use UNESCO Coupons and over 5 million dollars' worth of coupons have been put into circulation.

Full details of the UNESCO Travel Coupon Scheme may be obtained from the UNESCO Coupon Office, 19, Avenue Kleber, Paris 16$^e$, France.

## Heavy Water Reactor at Harwell

Britain's first heavy water reactor, or atomic pile, which has been built at the Atomic Energy Research Establishment, Harwell, is a low-powered thermal neutron research reactor. The heavy water moderator is contained in a tank surrounded by a graphite neutron reflector, outside which is a concrete radiation shield. The reactor fuel is submerged in the heavy water. The type of fuel as well as its arrangement in the tank can be changed quickly so that what is, in effect, a different design of reactor can be built up in a matter of a few days.

The reactor will be operated only at very low power so that its structure does not become sufficiently radioactive to prevent the necessary handling. One of the first functions of the reactor will be to carry out experimental work for E 443, the new and more powerful heavy water reactor which is being built at Harwell to provide the high neutron flux essential for some research purposes. E 443 will be a small, highly specialized unit for the more immediate testing of the materials used in nuclear reactors. This becomes more necessary as reactors of more advanced design are being considered. With the existing facilities at Harwell tests of materials may take up to a year. With E 443 a maximum of about 10 days should be enough.

Like the American Materials Testing Reactor, built at Arco Idaho in 1952, it will use uranium, but highly enriched with U 235 from the gaseous-diffusion plant at Capenhurst. This makes for a smaller and cheaper reactor. Size is also reduced by the use of heavy water as a moderator. The reactor has been quaintly named the *Dimple,* which is short for 'Deuterium Moderated Pile, Low Energy'.

## Report on ACTH and Cortisone

The British Medical Research Council Report, 1952-53, says that research into the use of the drugs cortisone and ACTH in the treatment of rheumatic diseases has enabled a more balanced view of the value of these hormones to emerge. The danger of ACTH and cortisone therapy would seem to be far from negligible.

Above a certain dosage side-effects, such as coarsening of appearance, increase in weight, hairiness, and so on, might appear. Experience tended to show that the minimum doses required to maintain freedom from joint symptoms were commonly at or above the level which produced such side-effects. There were also more serious dangers. High blood pressure, heart failure, diabetes mellitus, activation of latent tuberculosis, perforation of peptic ulcers and mental disturbances had all been reported as occasional complications. To some extent these could be prevented by excluding from the treatment patients who showed even the slightest evidence of any of these conditions. The report adds that therapy with ACTH and cortisone should never be undertaken lightly, and concludes that it is too early to determine the part that hormones will ultimately play in the treatment of rheumatoid arthritis.

## Geological, Mining and Metallurgical Society of India

At the Thirtieth Annual General Meeting of the Society held recently, the following officers for 1954-55 were elected:—*President* : Mr. M. K. Ray, Achipur ; *Vice-Presidents* : Mr. J. N. Mukherjee, Calcutta ; Mr. W. B. Metre, Dhanbad ; *Joint-Secretaries* : Prof. N. N. Chatterjee, Calcutta ; Prof. N. L. Sharma, Dhanbad ; *Members of the Council* : Mr. B. Bhargavan, Sambalpur ; Mr. D. K. Chakravarty, Benares ; Mr. P. K. Chatterjee, Calcutta ; Mr. Jayantilal Ajha, Calcutta ; Mr. N. N. Kapur, Jharia ; Prof. S. R. Narayana Rao, Lucknow ; Dr. M. S. Patel, Bombay ; Mr. M. G. Rawell, Nagpur.

## Burmah-Shell Loughborough Scholarships for 1954

The Burmah-Shell Loughborough Scholarships for 1954 have been awarded to Devendra Sahai and Sundarshan Kumar Maini, both of the Banaras Hindu University.

# SCIENCE AND HUMAN NATURE

THE dawn of the scientific era has been something of an adventure into the unknown, and no wonder each step that carries us forward is also fraught with fresh hopes and fears.

We all know where our curiosity has landed us: with advances in atomic physics which might be applied to devastate half the world, and if they were so applied would certainly make life in the other half extremely precarious. Our grandfathers were faced with scientific discoveries which were no laughing matter, for to many of them they spelled the end of all worthy human aims, but we face discoveries which might spell the end of all human aims, worthy or not.

In his Presidential Address to the British Association at its Oxford Meeting this year, Dr. Adrian is quite outspoken about the dangers which might arise from any future misuse of atomic energy. He has however shown that the hopes for the future can be bright provided we make a proper start right now in the study of the human factors which have led up to this situation. Thus, we can regret that atomic bombs are possible without regretting the discoveries that have led to them. Advances in natural science cannot avoid advancing the methods of warfare; they do so, when they make armies more healthy as well as when they increase the power of their weapons. But although the strategists have to think mainly of immense explosions and great devastation, it would be a mistake to suppose that these are the only dangers. Even if we can survive, then we must face the possibility that repeated atomic explosions will lead to a degree of general radioactivity which no one can tolerate or escape.

We are afraid, and rightly, because we cannot trust ourselves to act peaceably, because we know that unless we are ready to give up some

of our old loyalties, we may be forced into a fight which might end the human race. Our predicament then is the inevitable result of our curiosity and of the physical nature of the world that we live in. According to Dr. Adrian, it is time we made headway in learning as much as possible about the mental and physical causes which makes us behave as we do. A scientific study of human nature may well enable us to prevent its failures.

We do know of course an immense deal about human behaviour, from our own experience and from the accumulated wisdom of the past, but it is only in recent times that we have tried to check our knowledge by the mehods of natural sciences. The development of physical sciences dates from the time when direct observation and experiment were accepted as better guides than the principles which had seemed self-evident to the philosophers and the schoolmen. They were wise enough, but it was found that they could be mistaken. And so now we can look to the many branches of social science to make a dispassionate study of what actually happens in our society without regard to what might be expected to happen if we are to believe all that we have been taught. Indeed, one might say that the stage is nearly set for the new development and it might well be the most important scientific development in the present century. But why are we still reluctant to think well of it ?

Probably the answer is, we are not yet convinced that the kind of observations that the social scientist can make will be sufficiently objective and sufficiently precise. Those of us who work in laboratories have a far easier task in selecting what we should observe, yet we know how difficult it is for us to select and observe truly. We have to school ourselves not to reject the exceptional result as worthless when it does not fit in with a cherished theory ; we have to be continually aware of our fallibility even though we have all the figures and controls to keep us straight. With such experience before us we are loth to believe that the social scientists are more openminded than we are. The material they have to deal with seems to need an almost superhuman openmindedness combined with an almost superhuman power

of selection, of seeing the wood as well as the trees in it. We feel that we should be lost in such a wood where everyone must feel the bias of his own upbringing and social ties, where there is so much that cannot be measured and may or may not be relevant and where there is rarely any opportunity to check the conclusions by experiment.

But to give way to such feelings would hardly seem to be proper. Perhaps we have forgotten how much we distrusted some new development near to our own field of science because it was unfamiliar and because we thought its backers claimed too much for it. We ought to remember that the now flourishing science of biochemistry was once distrusted by chemists as well as by physiologists. It is human nature for the guild of natural scientists to delay admitting a new member till he has paid his dues and satisfied the examiners of his competence in the craft.

At present there are many kinds of investigation grouped under the umbrella of social science : the groups seem to have little in common and few of them can put their results into figures, but it cannot be denied that scientists and laymen alike are becoming more and more aware of the value of social investigation and of the degree of certainty that it can bring. We can see too that the search for these facts can be conducted on reasonably scientific lines. It is therefore too early to be cautious in spending money on large-scale investigations. They are bound to be costly and those of the social scientists deserve not only the support of national and international funds. There is this kind of support for the subject already, but it is too important a plan to be left in the hot-house atmosphere of research institutes and UNESCO teams. It deserves to be in full contact with all the conservative and academic people in Universities, the lawyers and historians as well as the economists, biologists and statisticians.

It may be that the search into the innermost recesses of human nature calls for a scientific temper bordering on the sublime ; but the search is no doubt worth making, as much for the dignity of science as for the larger purpose of serving the ends of humanity.

# A DYNAMIC APPROACH TO TISSUE DIFFERENTIATION

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## 1. EARLY VIEWS

THE problem of tissue differentiation has intrigued biologists of all ages. It would be refreshing, therefore, to commence an analysis with some of the earlier speculations. Spencer and Darwin postulated that the determiners of heredity circulated through the body. While the physiological units of Spencer were supposed to be alike, the gemmules of Darwin were as varied as the special cells they represented. Inheritance of acquired characters was conceded by both the investigators. According to Darwin environmental alterations get reflected in the gemmules produced by the tissues or organs. The method of transmission to the next generation was conceived to be by the collection of representatives of the different types of gemmules in the germ cells. A reversal of this process during ontogeny is a natural corollary. The products of division of embryonic cells are entered by gemmules representing the next stage of development which, by a process analogous to fertilization, determine their transformation into the type of body cell they represent in the adult organism (Herbert,[1] p. 54). In other words, during histogenesis, there is a "sorting out" of the hereditary particles. The views of these early biologists reveal the necessity felt by them to explain in a rational manner not only the origin of tissues but their integration in the scheme of organisation of an adult plant or animal.

Weismann who enunciated the germ plasm theory was critical of Darwin's views. He argued that if the characteristics of cells are determined by gemmules, and the gemmules representing all the cells are present in the zygote, it is easy to explain the specific orientation of tissues and organs because the gemmules are available whenever and wherever they are wanted (Herbert,[1] p. 55). But then the necessity for an explanation of the integrated series of phenomena seen during development would still be there. He speculated that many somatic mitoses may not be equational "but in reality qualitative (erbunglich)" (Sharp,[2] p. 482). The mechanism for "sorting out" of the hereditary particles was conceived by Weismann to be in the nucleus itself. It would appear that this suggestion may turn out to be rather prophetic.

Embryonic development, Conklin[3] observes, "consists of differentiations built upon preceding differentiations" (p. 593). Since development is initiated by fertilisation, evidences for differentiation may be available at or immediately after fertilization. *Is the source of differentiation the nucleus, the cytoplasm or both* ? The discovery of the organ forming substances[3] in conjunction with the slow establishment of the dogma that all the cells of an organism have the same chromosome number[4] led to the view that it is the cytoplasm which plays a dominant role. It is this aspect which is emphasized in text-books. The argument is rather simple. Since histogenesis is not accompanied by a parallel differentiation of the gene complex, it has to be conceived that protoplasm with a given gene complex is capable of a wide variety of reactions in response to the changing local conditions during development. "In harmony with this interpretation is the fact that it is in the cytoplasm, rather than in the nucleus that most protoplasmic differentiation is manifested" (Sharp,[2] p. 489).

The above conclusion is based on the following considerations. The chromosome number is constant in all cells of an organism and hence there can be no change in the gene complex during development. The inference would be valid only if the facts are true. A direct analysis of the inference is precluded owing to the following reasons. (*i*) "The Mendelian theory has so far been concerned with heredity rather than development"[2] (p. 489). (*ii*) Many of the morphological characters used in genetic analyses are products of irreversible differentiation. (*iii*) There is the whole world of embryonic development between the gene complex in the zygote and the determination and expression of the characters they represent in the adult[2] (p. 489). The concept that no change occurs in the gene complex during ontogeny is, therefore, not based on any direct evidence. It could perhaps have been justified, and that only in an indirect manner, if the chromosome number is constant in all cells of an organism. But is the chromosome number constant in all cells of an organism ?

## 2. NUCLEAR PHENOMENA ACCOMPANYING TISSUE DIFFERENTIATION

(*i*) *General.*—It has been recognised for some time now that the different tissues in the same

organism do not all have the same cytological make-up. "The statement made in most elementary accounts that all the nuclei of an organism contain the same number of chromosomes is only a first approximation to truth. Its frequent reiteration has, however, blinded many biologists to the fact, which has long been known (although its significance has only recently become apparent), that many of the differentiated cells of an adult organism are polyploid, that is to say, they contain 2, 4, 8, 16.... times the diploid (2 N) number of chromosomes. This phenomenon is in general, only exhibited by the nuclei of cells which have differentiated so far that they have lost the power to divide by mitosis, unless reactivated to do so by some special treatment (*e.g.*, by growth-hormones in the case of plants)" (White,[5] p. 208).

*(ii) Difference in the Number of Chromosomes between the Germ Line and Soma.—* The earliest description of the difference in chromosome number between the germ track and soma is that of Boveri in *Ascaris*. The distinction starts even at the first cleavage, and becomes complete by the fourth. While in those cells destined to give rise to the germ track the chromosomes remain entire, in the others, they not only become subdivided into smaller pieces but their ends disintegrate in the cytoplasm[2] (p. 489). The suggestion that the chromosomes of the germ line of *Ascaris* are really polycentric[6] would not explain the loss of the ends of the chromosomes during the crucial stages of differentiation into germ and soma. Do the changes indicate a primary alteration in chromosome balance between the germ and soma ?

*(iii) Difference in the Number of Chromosomes between the Germ Line Cells, Mitotic Indifferent Cells of Different Sexes and Some Differentiated Tissues.—* A much more interesting example is *Sciara*.[7] There are generally 10 chromosomes in the spermatogonia and oogonia. The soma cells of the male showing mitosis have seven chromosomes while there are eight in the female. There is selective elimination of the paternal chromosomes excluding the X's and the 'limited' chromosomes during spermatogenesis. During the meiosis of the female, however, there is no irregularity. Immediately on fertilization, the zygote of *Sciara coprophila* contains one X derived from the egg pro-nucleus, two X's from the sperm and usually three L'S. This is said to be only

a passing phase. "During the process of cleavage a number of the chromosomes are eliminated both from the somatic cells and from the germ line, so as to restore the chromosome sets characteristic of the adult tissues"[7] (p. 203).

Apart from the occurrence of the 'limited' chromosomes in the germ track alone and the difference in the number of X's observed in mitotically dividing male and female soma cells, further alterations are reported in the salivary cells. In *Sciara,* as in other insects, the salivary chromosomes are polytene. They however differ from those of *Drosophila* in the absence of a chromocentre[7] (p. 43). We thus see a variety of chromosome complexes in the same insect.

It may be that *Ascaris* and *Sciara* are isolated examples where there is a difference in chromosome number in the embryo between even the mitotically dividing cells which eventually develop into the germ track and soma. Usually, the indifferent embryonic or meristematic cells and those of the germ track have an identical chromosome constitution. The major difference is between the meristematic or embryonic cells and those constituting the differentiated tissues. The nuclear changes observed when an indifferent embryonic cell starts on the road to differentiation have been described under a variety of terms. These diverse phenomena could be arranged in an ascending order of increasing complexity.

*(iv) Polysomaty.—* The occurrence of tetraploidy as a stage during differentiation has been reported in the case of *Allium*[8] and *Mimosa*.[9] One of the characteristic changes during differentiation is the lack of synchronization between chromosome reproduction and cytokinesis. While the case of *Allium* and *Mimosa* typifies skipping of a single cytoplasmic division, thus giving rise to the tetraploid condition a higher stage of chromosomal duplication is shown by *Spinacia*.[10,11] These *polysomatic* cells which exhibit an ascending series of chromosome complexity[11] are the result of the breakdown in synchronization between karyo- and cytokinesis at regular intervals. Double chromosomal reproduction in the interval between two cell divisions appears to be the mechanism responsible for the production of polysomatic cells. Polysomaty is characterised by (*a*) the occurrence of cells with multiples of the diploid number amongst meristematic cells, and (*b*) the ability of such cells to go through the same phases as the meristematic cells during division.

(v) *Endomitosis and Polyteny.*—Whereas there is only a lack of synchronization between chromosome reproduction and cell division in polysomaty, cytokinesis is absent in endomitotic cells. The connected series of events like chromosome reproduction as well as the separation of the replicas occur in the absence of any condensation of chromosomes and within an intact nucleus. Naturally, the chromosomes remain 'fuzzy' throughout the whole process[5] (p. 209).

Endomitosis is characterised by the individual chromosomes remaining discrete. If the homologues fuse together, the products of their repeated division would give rise to the typical polytene chromosomes of the salivary gland cells of insects. An interesting case of the occurrence of both polyteny and polyploidy has been reported in *Lestodiplosus*.[5]

(vi) *Endopolyploidy.*—In many organisms, the occurrence of chromosomal replication within an intact nucleus has to be surmised from indirect evidence. In *Gerris* the heteropycnotic X chromosome has been utilized as a guide to judge the degree of polyploidy of the individual cells. By counting the number of heteropycnotic X chromosomes in the resting nuclei Geitler concludes that the giant nuclei in the salivary glands may be 512- to 2048-ploid.[5]

Often, the variation in the number of heterochromatic bodies in the resting nuclei render accurate evaluation difficult.[12] Such cells which usually do not divide could be stimulated to do so by the use of plant hormones and thus reveal their chromosome complexity.[13]

The nuclei of the epithelial cells of the ileum of *Culex* larvæ do not show any heterochromatic bodies.[14,15] But from the somatic reduction divisions, that they undergo during metamorphosis, it has been estimated that they may be 32- or even 64-ploid.

Assessment of the degree of endopolyploidy based on the number of heterochromatic bodies or relative sizes of the nuclei can only be tentative. Though there is said to be a rhythmic increase in nuclear size accompanying chromosomal duplication in *Gerris*, instances are on record where, in spite of the hypertrophy of the nucleus, it was presumed to be diploid because it had only a single heteropycnotic X chromosome.[11] The premise on which such conclusions are drawn is that there is an equal duplication of all the chromosomes of the mitotic complement. Is there any justification for such a belief ?

(vii) *Differential Reproduction of Chromosomes.*—When a tissue becomes endopolyploid, it does not appear quite necessary that all the chromosomes of the mitotic complement should get duplicated to the same extent. In the nurse cells of the ovary of *Drosophila*, Schultz[16] reports—in an XXY form—that while the autosomes and the X chromosomes repeatedly reduplicate to give rise to the 512-ploid condition the Y chromosome is replicated only four times (p. 36).

(viii) *Alteration in the Structure of Individual Chromosomes.*—*Ascaris* is not unique in that at a critical stage of differentiation loss of chromosome ends occurs in some cells. In the cortical parenchyma cells of *Allium* loss of telomeres have been reported.[17] As a consequence the free ends of the chromosomes that come into contact are said to have a tendency to fuse.

The structure of the salivary chromosomes of insects has been under debate for the past two decades.[11] The technique which reveals the mid-prophase compound chromosomes of *Culex* uniformly stained shows the salivary chromosomes as consisting of alternating chromatic and achromatic discs. The removal of the achromatic regions from the salivary chromosomes, according to Berger[14] (p. 230), would make them chromatic throughout as well as restore the normal length ratio expected between them and the metaphase chromosomes. Can we consider that there has been a differential reproduction of the different regions of the same chromosome ?

Compared to their length at mitosis, the heterochromatic regions are said to be much shorter in polytene chromosomes. Taking for example the X chromosome of *Drosophila melanogaster*, it is on record that while during mitosis about one-third of its length is heteropycnotic, the same region occupies less than one-tenth its length in the salivary nuclei[7] (p. 41).

There is no uniformity in the diameter of the euchromatin lying distributed along the length of the salivary chromosome. There are waist-like regions as well as localised swellings. The chromatic bands are said to be constituted by granules corresponding to the chromomeres of ordinary chromosomes. In favourable regions these granules could be counted and those of adjacent bands are connected by fine longitudinal threads. The number of chromomeres in adjacent bands may or may not be the same. Two threads converge on each

granule when there are only half the usual number of chromomeres in that particular band[7] (p. 38). During meiosis the chromomeres are known to differ in size.[6] But if there has been equal replication of all chromomeres, the number of granules in all bands of a salivary chromosome should be the same. Can we presume, therefore, that there has been differential reproduction of the granules constituting the different bands themselves?

*(ix) A Question of Terminology.*—The investigators who reported polysomaty,[11,14,15,18] polyteny, multiple chromosome complexes and endopolyploidy never made any serious attempts to relate these phenomena to tissue differentiation. As would be evident from the preceding pages it is possible to arrange the different cytological changes observed during histogenesis in an evolutionary scale. The most complex condition where there is not only an absence of cytokinesis but also visible evidence for the reproduction of most of the chromosomes could be derived from polysomaty with periodic lack of synchronization between chromosome reproduction and cytokinesis. Polysomaty, endomitosis, polyteny and endopolyploidy could, therefore, be considered as mere variations on a basic theme. The striking feature in all these phenomena is the replication of all or many of the chromosomes. Histogenesis is a characteristic of higher organisms whether they be haploids, diploids or polyploids. And, it is during histogenesis that one meets with a variety of cytological phenomena. Clearly, they constitute a different order of changes unrelated to polysomy or polyploidy. It is to avoid confusion that Subramaniam[19,20] suggested the use of the general term *endopolyploidy* to refer specifically to the cytological phenomena observed during differentiation.

### 3. EMBRYONIC AND DIFFERENTIATED CELLS

The analysis presented above reveals the desirability for a revival in a general way of the old Weismannian concept of *germ* and *soma*. This becomes imperative when it is realised that in *Sciara* there is a difference in the chromosome number between cells of the germ track and the indifferent cells of the soma, though both show mitosis. So long as there was an apparent justification for the belief that all cells in the same organism had the same chromosome number, there was no imperative necessity to differentiate between germ and soma. It is in the above context that one has to view the geneticist's limitation of the term "germ plasm" specifically to chromosomes[2] (p. 485). Now

that ample proof regarding the invalidity of the law of constancy of chromosome number is available,[4,12] a revival of an analogous but fundamental distinction becomes necessary.

Admittedly while the instance of *Sciara* would suggest a rigid classification, it would be preferable to broaden it in view of the general identity in chromosome number between the indifferent cells of the germ track and the embryonic or meristematic cells. The disintegration of the primordial germ cells and the origin of the functional germ track from the indifferent cells of the early embryo are regular developmental phenomena in some insects[2] (p. 490). The number and behaviour of chromosomes are identical during *normal mitosis* whether it be in a cell of the embryonic tissue or the germ track. So long as they do not undergo any differentiation, mitotic cells are potentially immortal.

Lack of synchronization between chromosome reproduction and cytokinesis produces two distinct types of transformation. Functional germ cells *come into being as a result of chromosome reproduction being out of step with cytokinesis*[6] (p. 88). On the other hand, *suppression of cytokinesis to varying degrees*, during histogenesis, results in conditions described as polysomaty, endomitosis, polyteny and endopolyploidy.[21] We see thus that specialized cells whether they be the sperm or ova or those constituting the diverse tissues of an organism are *products of differentiation in opposite directions*. They resemble one another in that they have only a limited span of life. It would be desirable, therefore, to classify cells into two broad categories, *viz., (i)* EMBRYONIC, and *(ii)* DIFFERENTIATED. Tissues may contain embryonic cells for purposes of replacement of those lost due to senility and death.

### 4. POLYPLOIDY AND ENDOPOLYPLOIDY

Once the necessity for such a primary distinction is grasped, it would be obvious that polyploidy and endopolyploidy are unrelated phenomena. It is rather interesting to recall that Winkler[4] attempted such a distinction as far back as 1916. "The constancy of chromosome number is safeguarded even when there is vegetative reproduction, since plants grow with their growing points which, by definition are always embryonal........We therefore come to the view that the regular occurrence of polyploid cells in the somatic tissues of higher plants by no means refutes the law of constancy of chromosome number but must be

expected in view of the importance of the chromosome number for cell size"[4] (p. 13).

Apparently Winkler was trying to emphasize the salient fact that separation of diploids from polyploids is based on investigations of chromosome number in embryonic cells. Embryonic cells in diploids as well as polyploids are capable of differentiation into germ cells or as components of various tissues. And it is during tissue differentiation that the cells become endopolyploid. There is thus no reason to consider that polyploidy and endopolyploidy are interchangeable phenomena. Nor can it be assumed that viable polyploid types could be derived directly from endopolyploid cells.

The cytological events during histogenesis, therefore, can have a significance only to the origin of tissues and not, as in the case of polyploidy, to the hereditary make-up of the organism.

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# FRESH SOURCES OF SELENIUM

THERE is no known deposit of selenium as such which is worth mining. The element occurs with sulphide ores, and most of it is obtained as a byproduct in the electrolytic refining of copper. The "anode slime" formed in the process contains a fairly high proportion of selenium.

The U.S.A. is the biggest producer of selenium, all of it from this process, but its supplies are still not enough for its own industry, and it has to import more of it. Most of Great Britain's supplies of selenium come from Canada, again from copper refining plant. There are small quantities of selenium on the market which come from Sweden and Japan, but these are high priced compared with the Canadian selenium.

There is a possible source of selenium in Great Britain which is now being investigated by the Chemical Research Laboratory as a result of a survey of the selenium problem by the Intelligence Division of the Department. Iron sulphide, or pyrites, is used in Great Britain in the manufacture of sulphuric acid. Like copper sulphide, it contains selenium. Flash roasting of pyrites is one of the processes which

is used to avoid using sulphur as a raw material. The process is fairly new, but its use is expanding and it may produce quantities of selenium which would be worth recovering. The selenium is concentrated in the wastes, dusts and muds from the roasting plant. Little is yet known of the economics of recovery, but waste material from three plants have been examined at the C.R.L. The materials from one plant contain sufficient selenium to justify the hope that recovery would be worthwhile. As in copper refining the problem is to develop a method which will not interfere with the primary object of the process and be cheap enough and simple enough to make selenium production pay.

The potential yield from this source will run into tons, a valuable addition to present supplies. One of the speculative things about recovery is that pyrites varies so much in its content of selenium. The C.R.L. investigation shows, however, that the possibilities of augmenting supplies of this extremely valuable element in this way are well worth serious consideration.

## LUNAR RAINBOWS

THE characteristics of solar rainbows, both primary and secondary, are well known and also widely appreciated. The fact that rainbows at night time due to moonlight also exist is, however, not so widely known.

On the night of the 16th of July 1954 at Allahabad there was a sharp shower at about 8-30 p.m. The sky was covered by scattered dark clouds and the moon appeared to be remarkably brilliant whenever she had the opportunity of getting out of the clouds. The elevation of the moon by visual estimate was about 30° above the eastern horizon. Due west there suddenly appeared a fairly brilliant semi-circular arc, broad and exhibiting the usual colour sequence found in solar rainbows ; only the colours were rather faint. Soon, another semi-circular arc sprung up on the outer side of this. It was rather faint and colours could hardly be seen in it.

These arcs could at once be explained as the primary and secondary rainbows caused by the light coming from the moon, in other words, they were lunar rainbows. The secondary rainbow soon vanished but the primary one maintained itself in intensity and width for full 45 minutes. After this time the intensity of the primary bow went down rather at a rapid rate and soon the bow vanished.

During my thirty-two years of scientific career I have never witnessed any lunar rainbows nor have I any recollection of having seen a report about these in India.

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## BLOOD GROUPS AND DISEASE

STUDIES of the relation between blood groups and diseases (other than transfusion reactions) may be divided into two main classes : those concerned with the blood groups only of affected individuals, and those concerned with the blood groups of both mothers and their fœtuses in relation to the diseases of either or both. Restricting consideration to the classical or ABO blood groups, a recent issue of the *British Medical Journal* (1954, August 7, pp. 315, 321 and 323) contains three papers on the relation of blood groups to disease. All of them set out the results of statistical studies on the blood group frequencies in selected classes of sufferers as compared with those in the general population. The relative frequency of neoplastic diseases and of peptic ulcer in persons of different blood groups almost certainly depends entirely on individual susceptibilities : any persistent effort of maternal antibodies in the adult life of the offspring is extremely unlikely.

Professor Ian Aird and his colleagues have shown that persons of group A have a greater susceptibility to carcinoma of the stomach than those of other blood groups, and these authors have brought to light the even greater relative susceptibility of persons of group O to peptic ulcer. The fact that two of the diseases which show an excessive susceptibility in persons of a single blood group are connected with the stomach suggests that the secretion of blood group substances by the stomach may be involved. About 75 per cent. of persons secrete their particular blood group substance in both saliva and gastric juice, and the ability so to secrete is genetically determined. It is important, therefore, to know the secretor status as well as the blood group of persons suffering from the various diseases. It is important, furthermore, to try to determine whether the one blood group substance is actively pathogenic or whether the other substances are protective. Such knowledge may ultimately prove to be of value for prophylaxis and treatment of the diseases concerned.

Whatever may prove to be the reasons for these connexions between blood group and disease, they have profound implications for human evolution, since they provide part, at least, of the means long predicted by Sir Ronald Fisher and Dr. E. M. Ford whereby an active equilibrium may be maintained over many generations between the frequencies of the different blood groups.

# SPECIFIC INHIBITION OF HYPOTHALAMIC PRESSOR RESPONSE

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WHILE investigating the central actions of chlorpromazine (chloro-3-dimethyl amino– 3′ propyl-10 phenothiazine ; Largactil ; Megaphen; 4560 R.P.), Dasgupta and Werner[1] noted a suppressive action on the rise of blood pressure elicited by electrical stimulation of hypothalamic or medullary pressor areas ; the effect was most marked following intravenous administration of the drug to diencephalic (nonanæsthetised) animals and was observable in a low dosage range in which the drug is completely devoid of any peripheral action. Although a certain similarity was found between chlorpromazine and morphine as regards the suppression of some signs of "sham rage" in diencephalic animals,[2,3] a marked difference apparently exists, in so far as the latter drug does not affect responses obtained on direct electric stimulation of the hypothalamus.[4] Other drugs with central depressant actions have not yet been investigated under comparable conditions : it was therefore not possible to decide whether suppression of direct excitability of pressor areas in the hypothalamus is characteristic for chlorpromazine only or common also to other drugs with central depressant activity.

For the present series of experiments, pethidine and pentobarbitone have been selected. The methods of investigation were the same as in the experiments with chlorpromazine referred to previously[1] : cats were decorticated under ether anæsthesia, artificially ventilated (in muscle paralysis through decamethonium) and unipolar electrodes were inserted by means of a Horsley-Clark Stereotaxic apparatus, so that pressor areas of hypothalamus and medulla oblongata could be stimulated (square wave impulses, 100/per sec. ; 0,5 m. sec. pulse duration); the pressor responses were recorded by means of a Hg-manometer, connected with the common carotid artery. In some experiments, pressor effects resulting from electrical stimulation of the left splanchnic nerve (dissected from the dorsal approach) were also recorded in order to ascertain, whether and to what extent peripheral (e.g., ganglionic blocking[5-7]) effects could account for the observed action of the drugs on the centrally induced pressor responses. Only such experiments are reported in which the pressor effects resulting from central

and peripheral stimulation were of equal height and well reproducible in control periods.

The results with pethidine are summarised in Table I and one typical experiment is illustrated in Fig. 1.

TABLE I

*Results with pethidine in diencephalic animals*

| No. | Dose mg./kg. | Fall of B.P.[†] mm. Hg | Hypothalamic stimulation | Medullary stimulation | Splanchnic stimulation | Spontaneous waves |
|-----|------|------|---|---|---|---|
| 1 | 1, 0 | 10 | A | .. | .. | A |
| 2 | 3, 0* | 40 | A | .. | −30% | N |
|   | 5, 0 | 50 | .. | .. | −50% . | |
| 3 | 1, 0 | 50 | A | .. | +10% | .. |
|   | 2, 0 | 90 | A | .. | −40% | N |
|   | 3, 0 | 105 | A | .. | −60% | |
| 4 | 0, 7 | 50 | .. | −20% | .. | N |
|   | 3, 7 | 80 | .. | −90% | .. | |
| 5 | 2, 2* | 20 | A | U | .. | A |
|   | 4, 2 | 70 | A | A | .. | A |
| 6 | 0, 7 | 70 | .. | −10% | U | .. |
|   | 2, 7 | 80 | .. | −25% | −20% | N |
|   | 4, 7 | 80 | .. | −60% | −50% | |
| 7 | 2, 0 | 20 | .. | −15% | U | N |
|   | 4, 0 | 60 | .. | −60% | −20% | |
|   | 5, 0 | 70 | .. | −75% | −50% | |
| 8 | 1, 0 | 30 | A | −10% | .. | A |
|   | 2, 0 | 70 | A | −25% | .. | A |
|   | 3, 5 | 60 | A | −50% | .. | A |

\* Lower dose was not tried   † With reference to initial pressure A = abolished, U = unaltered, N = not present.

It is apparent from Table I that pethidine can in a certain dosage range abolish hypothalamic pressure responses under these experimental conditions without reducing the blood pressure rise caused by stimulation of the splanchnic nerve (see also Fig. 1); pressor responses resulting from medullary stimulation are about equally sensitive for the inhibition through pethidine as the responses obtained by splanchnic stimulation. Spontaneous blood pressor waves which are rather frequently found in diencephalic animals and which usually are of an amplitude of 50-70 mm. Hg, are however, as effectively suppressed by pethidine as the effects of hypothalamic stimulation. The different sensitivity of hypothalamic and medullary pressor areas is particularly obvious
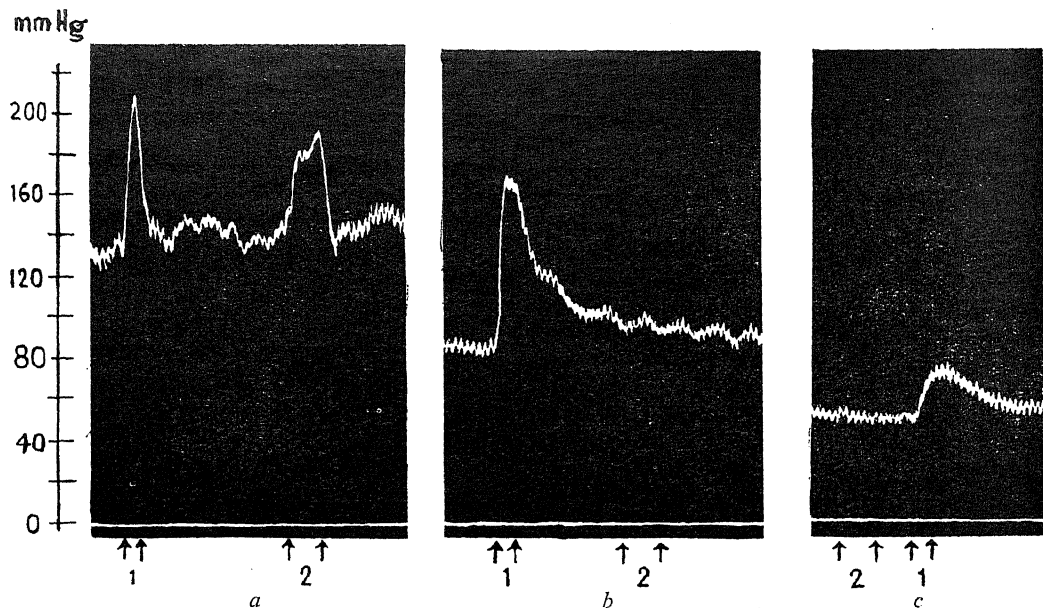
FIG. 1.    Blood pressure record of Exp. No. 3  (see Table I).   2. Stimulation of hypothalamic pressor area.
    1. Stimulation of left splanchnic nerve.

(a) Control responses.   (b) 5 min. after intravenous injection of 10 mg./kg. pethidine.   (c) 5 min. after intravenous  injection of  additional 3 mg./kg. pethidine (2 mg./kg. pethidine were administered 7 min. before that, the total dose difference between record b and c is therefore 5 mg./kg.).

in Experiments Nos. 5 and 8 (see Table I), where pressor responses of equal height were elicited alternatively from the two areas of stimulation, but only the hypothalamic responses were suppressed in a certain dosage range.

The considerable fall of blood pressure obtained already after low doses of pethidine is striking in these experiments and apparently due to the high blood pressure which the diencephalic animals showed to start with, presumably as a result of hypersecretion of pressor amines from the adrenal medulla[8], it is obvious that the central blocking effect of pethidine on the hypothalamus will appear more effective against the background of such high sympathetic activity induced by decortication.

The results with pentobarbitone were less conclusive : the hypothalamic pressor response was in three experiments abolished by doses of 3,0 to 5,0 mg./kg.; however the blood pressure rise caused by stimulation of the splanchnic nerve in the same experiments was also considerably reduced : a specific action on hypothalamic pressor areas cannot therefore be demonstrated for pentobarbitone under such experimental conditions.

Central depressant drugs apparently differ in their pattern of activity in so far as some of them can be shown to suppress the direct ex-

citability of hypothalamic pressor areas in diencephalic animals, in doses which are devoid of peripheral effects (i.e., chlorpromazine, pethidine); a difference exists, however, between these two drugs in so far as chlorpromazine affects both the excitability of hypothalamic and medullary pressor areas to a similar extent whereas pethidine appears to affect the latter, if at all, to a lesser extent.  In the case of pentobarbitone, central actions on the hypothalamus cannot be demonstrated under the conditions of these experiments, since peripheral  (presumably  ganglionic  blocking[6,7]) actions can fully account for the observed results.

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# LETTERS TO THE EDITOR

## OSCILLATIONS IN NITROGEN GLOW DISCHARGE

A VERY interesting account of the nature of electrical oscillations produced in the positive column of the discharge tube, has been given by J. J. Thomson (Phil. Mag., Vol. XI, Jan.-June, pp. 697, 1931) and the present work is on the same line as Thomson's. The various types of luminous oscillations which reveal them-selves in the rotating mirror as some lines, are called by J. J. Thomson as α, β and γ lines. He attributes the origin of the α-lines to a sort of explosion taking place in the discharge at regu-lar intervals. The β-lines are due to the intermit-tence in the positive column and the γ-lines represent the ionic vibrations which are set up by the disturbances caused by explosions which give rise to α-lines.

It is found that the impurities in the gas, increase in the pressure of the gas and cur-rent make the discharge highly unsteady. The lower limit of current for a steady discharge is found depending on the pressure in the dis-charge tube. The lower the pressure, the smaller is the strength of the current required to maintain a steady glow.

The frequency of the lines was found by a revolving mirror. As the number of lines is usually too large to be counted in the whole field of view, a reviewer with a small field of view was used for observing them. By this method the order of the frequencies of α and β were found to be $3 \times 10^2$ cycles and $10^5$ cycles respectively.

The high frequencies were measured by a Heterodyne wavemeter.[1] The coupling coil is placed near the field of the transmitter and the condenser is adjusted till the heterodyne beat is heard in the telephones. The wave-length of the wavemeter then coincides with that of the transmitter and the actual wave-length is obtained from the calibration chart. The values of the frequencies found were slightly different at different stages. Five

different frequencies have been found which are given in Table I.

### TABLE I

*Frequencies observed in the discharge*

| Discharge Potential in volts | Pressure in mm. | Frequencies in Mc./s. | | | | |
|---|---|---|---|---|---|---|
| 5600 | 0·015 | 0·236 | 0·595 | 0·735 | 1·625 | 2·27 |
| 2900 | 0·029 | .. | 0·61 | .. | 1·625 | 2·25 |
| 2000 | 0·04 | .. | .. | 0·735 | 1·66 | 2·56 |
| 980 | 0·1 | 0·236 | .. | .. | 1·69 | 2·45 |
| | Mean | 0·236 | 0·603 | 0·735 | 1·65 | 2·38 |

An oscillograph was also used to study the voltage oscillations. As a suitable voltage divider to bring out the voltage across the discharge tube to within 450 volts (the highest voltage that can be applied to the oscilloscope input) was not available, direct observations were not possible. An indirect method which can give a qualitative picture of the discharge tube was used. Current oscillations were also studied. The voltage developed across the resistance included is applied to the horizontal plates of the oscilloscope. The patterns on the screen indicate the variations in the current of the discharge tube circuit. The frequencies of the different types of oscillation were measured with the oscilloscope and were found to be nearly the same as that obtained with wavemeter. The frequencies of the striations which are a common feature of the positive column of a glow discharge were found to vary from 40 to 800 cycles.

I am grateful to Dr. B. Dasannacharya for guidance.

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Banaras Hindu University,
*May* 21, 1954.

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### CALCULATION OF THE DIPOLE MOMENTS OF TRI–SUBSTITUTED BENZENES

A GENERAL method is worked out for the theoretical calculation of the dipole moments of 1 : 2 : 4-tri-substituted benzenes following the lines of Smallwood and Herzfeld[1] for the di-substituted benzenes. The total moment of a tri-substituted benzene compound comprises of (1) the vector sum of the moments of the primary dipoles, (2) the mutual induction of the three primary dipoles on one another, and (3) the moments induced in the –CH and the –C-C bonds of the hydrocarbon residue by the

primary dipoles. A correction is also applied for the dielectric constant of the internuclear space as has been suggested by Le Fevre.[2]

The final equation giving the dipole moment M of the compound is given as

$$M = \sqrt{M_x{}^2 + M_y{}^2} \qquad (1)$$
where
$$M_x = 2\cdot3652\,\xi_1' + 1\cdot07456\,\eta_1' + 1\cdot3171\,\xi_2' + 0\cdot2809\,\eta_2' \\ + 2\cdot3326\,\xi_3' + 1\cdot01432\,\eta_3'$$
$$M_y = 0\cdot9254\,\xi_1' + 0\cdot7710\,\eta_1' + 0\cdot2809\,\xi_2' + 1\cdot9135\,\eta_2' \\ + 1\cdot0143\,\xi_3' + 0\cdot8454\,\eta_3'$$

$\varsigma$'s denote the X-components and $\eta$'s denote the Y-components of the moment as modified by the induced effects.

The values calculated for five compounds for which experimental data are available, are given in Table I.

### TABLE I

| Compound | M$_{vect.}$ | M$_{eq.}$ (1) | M' | M$_{obs}$. |
|---|---|---|---|---|
| 1 : 2 : 4-Trichloro-benzene | 1·64 | 1·24 | 1·40 | 1·25[3] |
| 2 : 4-Dinitrochloro-benzene | 3·26 | 3·14 | 3·19 | { 3·0 ± 0·1[4] <br> { 3·29[3] |
| 2 : 4-Dinitrobromo-benzene | 3·26 | 3·72 | 3·54 | 3·1 ± 0·1[4] |
| 2 : 4-Dinitroiodo-benzene | 3·31 | 4·92 | 4·29 | 3·4 ± 1[4] |
| 2 : 5-Dichloronitro-benzene | 3·75 | 3·31 | 3·48 | 3·45[3] |

The first column (M$_{vect.}$) gives the moment in Debye units obtained by the simple method of vectorial addition, the second (M$_{eq.(1)}$) gives the value calculated according to Eq. (1) and the third (M') gives the value when the correction for the dielectric constant of the internuclear space is also incorporated. The difference between M$_{vect.}$ and M$_{eq.(1)}$ which gives the induced effect is multiplied by the factor $\dfrac{\epsilon+2}{3\epsilon} = \dfrac{4\cdot4}{7\cdot2}$ ($\epsilon$ the dielectric constant of the internuclear space being taken as $2\cdot40^2$) to give the actual induced effect. This is added algebraically to M$_{vect.}$ to get the value under the head M'. The last column (M$_{obs.}$) gives the observed value.

Details of the calculation and the discussion of the values will be published elsewhere.

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Andhra University,
Waltair,
*July* 23, 1954.

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## ULTRASONIC VELOCITY AND MOLECULAR VOLUME

IT was shown by Rao[1] that the thermal coefficient of velocity of sound $v$ in organic liquids is about three times the thermal coefficient of density $\rho$. The relation can be written

$$v^{\frac{1}{3}} V = R \qquad (1)$$

Here R is a constant independent of temperature and V is the molecular volume $M/\rho$. R was found to compare favourably with the parachor as far as its additive properties were concerned. It was shown that plot of R against M resulted in a series of straight lines for each homologous series represented by the equation

$$R = \alpha M + \beta \qquad (2)$$

$\alpha$ was shown to have the same value (14) and $\beta$ was found to be different for different homologous series. Parthasarathy[2] found that by plotting $v^{\frac{1}{3}}/\rho$ against $1/M$ a family of straight lines is obtained, satisfying the equation

$$v^{\frac{1}{3}}/\rho = A + B/M \qquad (3)$$

where A is 13·56 which is the same for all series and B varies from series to series. Equations 2 and 3 are algebraically the same.

The proof of the constancy of $\alpha$ in (2) and A in (3) is simple. If $R_1$, $R_2$ are the values of R for two successive members of homologous series, then the difference in the value of R divided by 14, the molecular weight of $CH_2$ gives the value of $\alpha$ or A which according to Rao is 14 and 13·535 accordnig to Lagemann, McMillan and Wolsey,[3] and 13·56 according to Parthasarathy. Rao took the average value of R = 195 for a number of series including alcohols. It would therefore appear that more measurements of the velocity of sound on a larger number of series are needed to check up the value of the difference in the value of R for two successive members. It is very easy to extend this result to the case of parachor on similar grounds. The constancy of A or $\alpha$ when $v^{\frac{1}{3}}/\rho$ is plotted against $\eta$ is to be traced to the same cause, namely, that R is additive. But the fact remains that such a relation holds only for one temperature, as $\eta$ varies considerably with temperature.

The quantity R is an additive function as the parachor is. It is known that the molecular critical volumes are additive. Since R is independent of temperature and has the property of being additive, one naturally thinks of comparing R with $V_c$. It was shown by Rao[4] that the ratio of R to V is a constant for most substances. We will be then comparing quantities

which are not dimensionally the same. Instead of expressing R in terms of length, mass and time, if we build up a dimensional equation in terms of energy, length and mass then R could be expressed as (energy)$^{\frac{1}{6}}$ (length)$^3$ and (Mass)$^{-\frac{1}{6}}$. Since R is nearly proportional to $V_c$ any departure from the constancy of the ratio is to be attributed to other factors not taken into consideration. Since we are considering the molecular critical volume, the other corresponding quantities will be the critical temperature, and critical pressure. Either of these could be used to build up the equation. Since energy is directly proportional to the temperature we replace the energy term by $\theta_c$. Thus R can be expressed

$$R = R' \left( \frac{\theta_c}{M} \right)^{\frac{1}{6}} V_c \qquad (4)$$

The constancy of R' is very much better than the constancy of the ratio $R/V_c$ as found from an examination of 30 substances. From the known values of $\theta_c$, $V_c$ for any liquid and from the mean value of R', the R value for any liquid could be found and hence the velocity of sound in the liquid at any temperature knowing its density at that temperature. In the intermolecular potential used by Lennard Jones and his collaborators the quantities $\phi$ and $r_0$ which are constants of energy and length characteristic of the molecule are found proportional respectively to $\theta_c$ and $V_c^{\frac{1}{3}}$. We may, therefore, write equation (4) as follows:

$$R = R'' \left( \frac{\phi_0}{M} \right)^{\frac{1}{6}} V_c \qquad (12)$$

where R'' is a temperature-independent constant, the same for all substances. From the interpretation of $r_0^3$ as a collision volume we would expect R to be additive when more complicated molecules are built up as the contribution of the term $(\phi_0/M)^{\frac{1}{6}}$ is indeed small. The utility of the function R in studying molecular association has been pointed out by Lagemann[5] and his collaborators. The additive property could be extended to solution as was first pointed by Rao in 1940.[1] Starting from the equation of state of the type

$$Pv + f(v) = \frac{\gamma_m E}{\lambda} \qquad (5)$$

after Van Laar,[6] we can show by a little calculation that the adiabatic compressibility $\beta_\phi$ can be put as

$$\beta_\phi = 1 \bigg/ \left[ P \left( 1 + \frac{\gamma_m}{\lambda} \right) + \frac{\gamma_m}{\lambda} \frac{f(v)}{v} + f'(v) \right] \qquad (6)$$

If we neglect P the external pressure with reference to the internal pressure

$$\beta_\phi = 1 \Big/ \Big[ f'(v) + \frac{\gamma_m}{\lambda} \frac{f(v)}{v} \Big] \qquad (15)$$

which is a pure function of the volume. In particular Rao's equation is obtained if $f(v)$ is assumed to be of the form $\lambda/v^n$ where $n = 6$.

Further details will be published elsewhere.

Meteorological Observatory,       M. RAMA RAO.
New Delhi,
*August* 10, 1954.

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3. Lagemann and Collaborators, *J. Chem. Phy.*, 1948, **16**, 247.
4. Rao, *Ind. J. Phy.*, 1940, **14**, 109.
5. Lagemann, etc., *J. Chem. Phy.*, Dec. 1947.
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## MICROLITHIC INDUSTRY OF KIBBANAHALLI, MYSORE STATE

IN and round Kibbanahalli, a large number of paleolithic artifacts were discovered by Prof. Sampath Iyengar and Prof. L. Rama Rao in 1924 and 1928 respectively. At the foot of
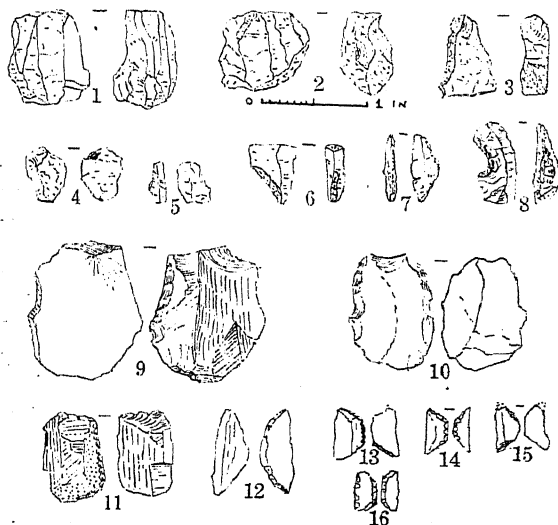


FIG. 1. *Microlithic artifacts from Kibbanahalli, Tumkur District, Mysore State:*

1-2. Fluted Cores. 3. Transverse arrowhead ? 4-5. Microburins. 6. Tanged blade. 7, 12, 14, 15 and 16. Lunates. 13. Trapeze. 8. Spokeshave. 9. Large flake used as side scraper. 10 and 11. Parts of exhausted cores retouched and used as side scrapers.

the ridge, there are a number of small spurs, extending towards the cultivated lands of the village of Kibbanahalli. The microliths along with considerable waste material were discovered by Mr. and Mrs. Allchin, of the London University Institute of Archæology, who visited that area in 1951 at the suggestion of the writer. Further visits to the site in 1953 by the writer resulted in the discovery of a few more microlithic artifacts.

The Kibbanahalli microlithic industry, almost entirely of quartz, consists of cores which are mostly blade cores, though a few flake cores are present. Some of the large flakes have been slightly retouched and used as side scrapers (No. 9, Fig. 1). Other flakes which are small have also been used, a few possibly as transverse arrowheads (No. 3).

There is an interesting series of blades, some of which have been used as such; a few have been backed, and three have been transversely broken with retouched ends. Some of the blades are tanged also (No. 6).

In addition to the side scrapers already mentioned, there are a few specimens of hollow, double hollow and end scrapers.
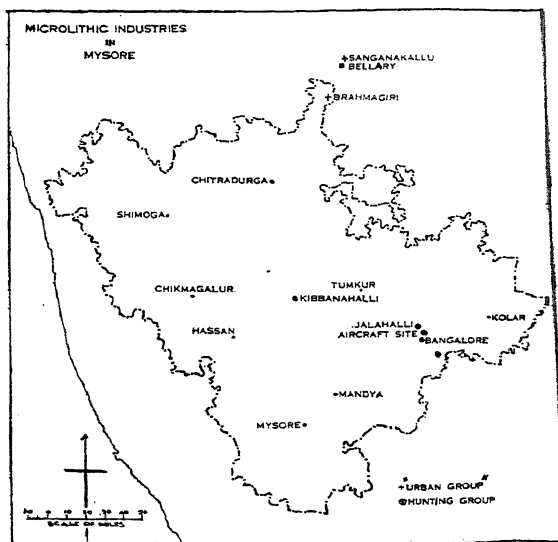


But the most finished artifacts of the whole assemblage are the lunates (see Plate I). Of the five lunates, none has the chord trimmed. The sixth specimen may be regarded as a trapeze (No. 13). There is only one poor specimen of an obliquely retouched point.

Certain differences can be marked between the Jalahalli and Kibbanahalli industries. The

presence of the microburins may be regarded as a waste product and therefore is not significant. The absence of the burin in the Kibbanahalli industry should, however, be regarded as a differentiating feature and the Kibbanahalli industry is characterised by the rarity of asymmetrical backed points, but the assemblage is much too small to draw any significant conclusion.

Tentatively, therefore, the Kibbanahalli microlithic industry is distinguished into a third group, apart from Jalahalli and Brahmagiri I 'A' and 'B' industries respectively. Whether this new group can be separated from Brahmagiri Pre-I cannot be decided until more collections have been made at Brahmagiri.
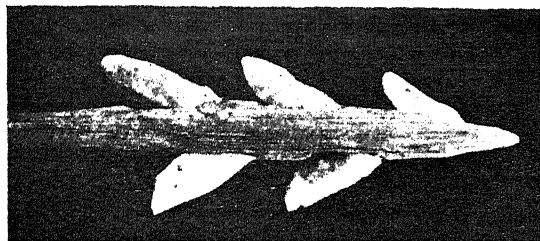


PLATE 1. Lunates and asymmetrical points used as arrowbarbs (After Leakey).

It would appear, therefore, that four microlithic phases can be tentatively distinguished in Mysore State : (1) Jalahalli, (2) Brahmagiri Pre-I, (3) Kibbanahalli, and (4) Brahmagiri 'A' and 'B'. The argument for the distinction of (2) and (4) has been put forward elsewhere.[1] Typologically, the four phases are different, too, though the material from (2) is scanty.

There is no evidence for determining the age of the Kibbanahalli industry. All the finds come from the surface. Careful excavation of these spurs where the microliths were picked up could yield valuable information. At least, the association or non-association of pottery with these microlithic artifacts could be established. Typology is elusive and cannot help to elucidate the question of chronology. More intensive work on the site would be amply rewarded.

M. SESHADRI.

Maharaja's College,
Mysore, *July* 24, 1954.

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## AN UNREPORTED BAND OF INTER-TRAPPEANS IN THE RAJAHMUNDRY AREA

DURING recent fieldwork in Rajahmundry area in the East Godavari District, exposures of calcareous bands consisting of marl and limestone were noticed underlain and overlain by Deccan traps.

Dr. M. S. Krishnan records about the Pangudi and Dudukuru area in the West Godavari District : "At least three flows of the trap can be made out, the lowest resting on the infra-trappean marls and containing in its upper part amygdaloidal cavities with agate and chalcedony. The junction between the lower and the middle flows is marked by a bed of limestone (Intertrappeans). The two upper flows are on hillocks where they are worked for road metal in a few places".[1] About the limestones of the Rajahmundry area he writes, "Intertrappean limestone occurs near Kateru, a couple of miles north of Rajahmundry under geological environments similar to those of Kovvur area".[2] Venkayya[3] also recognises only one intertrappean band in different quarries of the traps in the Kateru area.

A careful attempt was made during the present work to note the heights above mean sea-level of the occurrence of the exposures of the Intertrappean limestone bands in the different localities, their dip and their thickness. The interpolated disposition of the Intertrappean beds from the outcrops and bore hole data are indicated in Fig. 1.
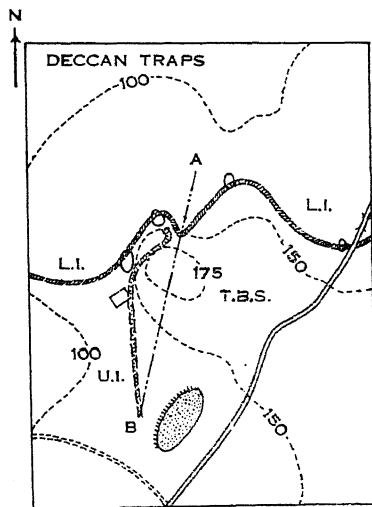


FIG. 1. Kateru Area. Scale : 1″ = 3 Furlongs.
L.I.—Lower Intertrappean.
U.I.—Upper Intertrappean.

Fig. 2 is a section in the direction N.N.E.-S.S.W. across the T. B. S. Hill. The exposures of limestone at the top of the north-western portion of the T. B. S. Hill (No. 3), in the
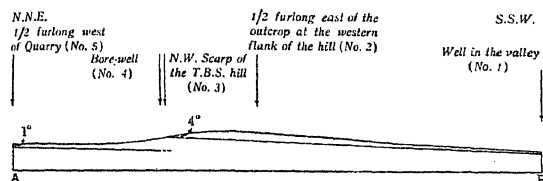


FIG. 2. Section along AB of Figure No. 1.

Scale $\left\{\begin{matrix} \text{Horizontal} \\ \text{Vertical} \end{matrix}\right\}$ $1'' = 1000$ feet.

western flank of the hill (No. 2), and in the well about 2½ furlongs south (No. 1) appear to belong to the same band. The limestone band occurs at about 100' in the well (No. 1), at 140' at the western flank of the hill (No. 2) and at 160' north-west of T. B. S. Hill (No. 3). These limestones have a southerly dip of about 4-5°. These are precisely the points where they would outcrop if they belong to the same band.

The study of the bore well log (No. 4) has brought to light the existence of a lower band of Intertrappeans. The bore hole just misses the upper limestone, penetrates through about 50' of Deccan trap and comes on to a limestone band which is 3' in thickness. This is again underlain by trap. The outcrop of limestone about 2 furlongs further north in a quarry (No. 5) is evidently a continuation of the band met within the bore hole. The band is 8' thick in this quarry. Variation in thickness of Intertrappean bands is a well known feature.

These field observations very clearly indicate that there are three trap flows separated by *two distinct Intertrappean bands in the Kateru area*. Study of the different outcrops in relation to their heights above mean sea-levels, the log afforded by the bore hole, and opening up of a scarp of the hillock recently have facilitated the recognition of a second band of Intertrappean in the Rajahmundry area.

My thanks are due to Prof. C. Mahadevan under whose helpful guidance this work was carried out.

Geology Dept.,      R. VAIDYANADHAN.
Andhra University,
Waltair, *July* 27, 1954.

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2. —, *Ibid.*, 1950, **81** (2), 301.
3. Venkayya, E., *Proc. Ind. Acad. Sci.*, 1949, **29**, 432.

## OCCURRENCE OF CALCIPHYRES NEAR MALLARAJANAHUNDI NANJANGUD (MYSORE STATE)

THE first reported occurrence of Calciphyres in Mysore State was near Nanjangud.[1] Recent geological work round about Nanjangud has revealed the occurrence of certain interesting limestone outcrops near Mallarajanahundi, about 8 miles N.-E. of Nanjangud.

The microscopic examination of a few representative slides of the limestones revealed a coarse granulitic texture with calcite, quartz, felspar, biotite mica, hornblende, augite, garnet, sphene and a lime-silicate mineral, spurrite. Spurrite occurs as colourless plates amidst the carbonate minerals and when the nicols are crossed, develops polysynthetic twinning. The twin lamellæ are bent and crumpled. It has high relief and a birefringence of 0·04, as determined by the Berek compensator. It is optically negative with $Y \wedge C = -33°$ and $2V = 40°$ as determined on the Federov's Universal Stage. A few grains of calcite develop biaxial character with $2V = 28°$ (as determined by the Mallard constant method) due to intense metamorphism which the rocks have undergone. Further work is in progress.

We are highly thankful to Dr. C. S. Pichamuthu for his encouragement and guidance in the work.

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Bangalore, *July* 5, 1954.

1. Rama Rao, B., *Mys. Geol. Dept.*, 1942, **41**, 18.

## L-GLUTAMIC ACID FROM AQUEOUS EXTRACTED CASTOR CAKE

AQUEOUS extracted castorcake has been found to be more suitable for the extraction of *l*-glutamic acid than commercially pressed castorcake. In aqueous extraction[1-3] where drying of the wet cake presents a problem, it was thought worthwhile to examine the possibility of isolating glutamic acid from the castorcake extracted by water, as this would be free of much of its water-soluble matter such as carbohydrate and inorganic matter which tend to retain[4] glutamic acid. A combination of Gilmans and Chibnall's[5,6] modified Ritthausen-Foreman methods for the isolation of glutamic acid has therefore been followed, using cake as the raw material rather than proteins.

Aqueous extracted castorcake (500 g. on dry cake basis) containing 20 per cent. moisture was hydrolysed for 18 hours with hydrochloric acid (1·375 litres) of sufficient strength to give a final concentration of 20 per cent., after making allowance for the water in the cake. The hydrolysate was concentrated and then filtered. The residue was washed thoroughly with concentrated hydrochloric acid. The filtrate along with washings was worked out for the recovery of glutamic acid.

The yields of glutamic acid from undefatted, defatted and aqueous extracted castorcake are recorded in Table I.

TABLE I

| Nitrogen content % | % Total Nitrogen appearing in Glutamic acid | % Yield of Glutamic acid |
|---|---|---|
| (1)  3·2 | 8·0 | 2·7 |
| (2)  4·6 | 7·4 | 3·6 |
| (3)  4·3 | 8·4 | 3·9 |

(1) Undefatted cake; (2) Defatted cake; (3) Aqueous extracted castorcake.

It is evident from the data given in the above table that the yield of glutamic acid from aqueous extracted castorcake is higher than that obtained from defatted and undefatted cake samples.

The glutamic acid sample obtained as above from the aqueous extracted castorcake showed nitrogen content 10·8 per cent., m.p. 192·7° C. and $(\alpha)^{30}_D = (+) 31·8$ while that of the standard sample are 10·9 per cent., 199·0° C., (+) 31·5 respectively.

The authors' grateful thanks are due to Dr. R. C. Shah for helpful suggestions and criticisms.

National Chem. Lab.          B. N. JOSHI.
    of India,          J. P. VERMA.
Poona-8, *June* 27, 1954.

1. Varma, J. P., *J. Oil and Oil Seeds*, 1952, **4**, 26.
2. —, *Indian Patent*, No. 41177.
3. —, *Ibid.*, 41178. No.
4. Mashino, M. and Shishido, T., *J. Soc. Chem. Ind., Japan*, 1930, **33**, 421; *cf. C. A.*, **24**, 3025 and **25**, 746.
5. Chibnalls, A. C. *et al.*, *Bio. Chem. J.*, 1940, **34**, 285-300.
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## C-METHYLATION OF ω-METHOXY-PHLORACETOPHENONE

DURING the course of synthetic work in progress, a considerable quantity of C-methyl derivative of ω-methoxy-phloracetophenone (I) was required. This has been achieved by the nuclear methylation of ω-methoxy-phloracetophenone (I) using the method of Curd and Robertson.[1] 2-Hydroxy-ω : 4 : 6-trimethoxy-3-methylacetophenone (II, R = CH₃) is a colourless crystalline solid and gives a prominent colour with alcoholic ferric chloride and a blue colour with 2 : 6-dibromoquinonechlorimide, the latter reaction indicating that the position para to the free hydroxyl is unsubstituted. The corresponding O-dimethyl ether (II, R = H) is also obtained in small quantity as a by-product.



(I)

(II)

(R = CH₃ or H)
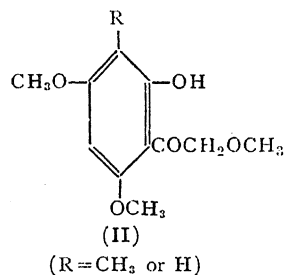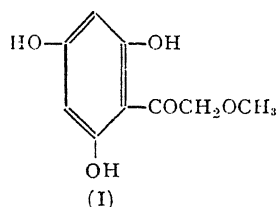
ω-Methoxy-phloracetophenone (2 g.) was gently boiled under reflux with methyl iodide (8 ml.) and anhydrous potassium carbonate (14 g.) in acetone solution (50 ml.) for about 3 hours. The potassium salts were removed by filtration and slow evaporation of the acetone solvent deposited slightly reddish-brown square pyramids and rectangular plates. Purification was carried out by dissolution in ether and washing with water wherein the coloured impurities were insoluble. Removal of the solvent left a residue which appeared as colourless long rectangular plates tapering at the ends. Crystallisation from methyl alcohol gave the product as long colourless needles slightly bulging at the centre, m.p. 141-42° C. Yield : 0·5 g. (Found : C, 55·9; H, 7·2; loss on drying at 110° C. for 2 hours in high vacuo, 6·9; $C_{12}H_{16}O_5$, $H_2O$ requires C, 55·8 ; H, 7·0 and loss on drying 7·0 per cent. Found in sample dried at 110°, C, 60·3; H, 6·9; -OCH₃, 39·0;

$C_{12}H_{16}O_5$ requires C, 60·0; H, 6·7 and —$OCH_3$, 38·8 per cent.). The dried substance melted at 176-77°. The alcoholic mother liquor on dilution with water precipitated a crystalline substance which was identified as 2-hydroxy-ω : 4 : 6-trimethoxy-acetophenone, m.p. 104-05° C. A mixed melting point with an authentic sample of 2-hydroxy-ω : 4 : 6-trimethoxy-acetophenone was undepressed.

The author desires to thank Prof. T. R. Seshadri for his interest in the work.

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Andhra University,
Waltair, *July* 20, 1954.

1. Curd and Robertson, *J. Chem. Soc.*, 1933, 437.

## A SYNTHESIS OF LUCIDIN

FROM the bark of *Coprosma lucida* Briggs and Nicholls[1] isolated a new anthraquinone colouring matter, lucidin, to which they ascribed the structure 1 : 3 : 5-trihydroxy-2-methylanthraquinone (I). Reconsideration of some of the properties and the infrared spectrum of lucidin led them subsequently to revise the constitution to 1 : 3-dihydroxy-2-hydroxymethylanthraquinone (II).[2] We have confirmed the latter structure (II) by an unambiguous synthesis.



(I)      (II)



(III)
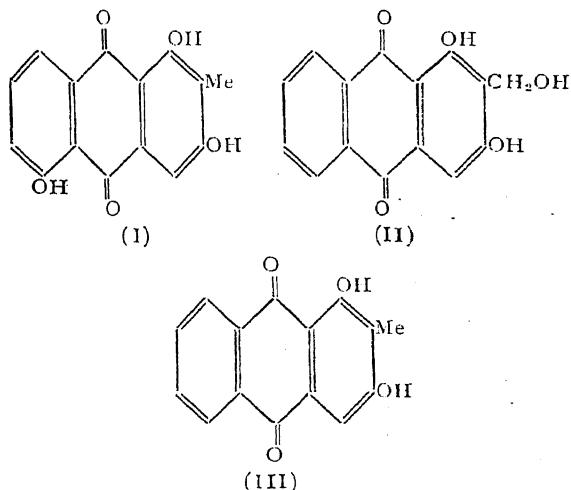
Rubiadin, 1 : 3-dihydroxy-2-methylanthraquinone (III), has been synthesised earlier by several methods, but all are tedious and give poor yields.[3] A greatly improved procedure is an application of the method of Marschalk et al.[4] for C-methylation in the anthraquinone series; thus the treatment of the leuco derivative of xanthopurpurin 3-methyl ether (IV)

with formaldehyde gave rubiadin 3-methyl ether (V), which was demethylated to rubiadin (III) by means of boiling hydrobromic and glacial acetic acids. A convenient route to (IV) was the deamination of 1-amino-2 : 4-dibromo-anthraquinone, replacement of bromine by methoxyl by refluxing with sodium methoxide in methanol, and partial demethylation of the resultant 1 : 3-dimethoxyanthraquinone with hydrobromic acid and acetic acid. Treatment of rubiadin diacetate with N-bromosuccinimide in boiling carbon tetrachloride gave the ω-bromo derivative (VI); the position of the bromine



(IV)      (V)



(VI)
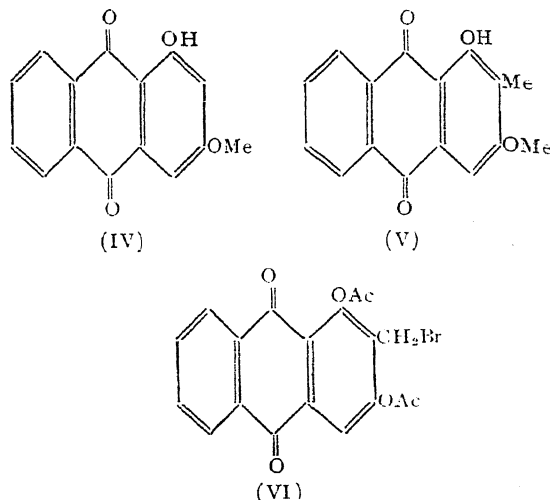
atom was indicated by the ready formation of a pyridinium salt. When (VI) was treated with sodium acetate in boiling alcohol, hydrolysis of both the bromine atom and acetyl groups took place, the product being (II), identical in all its properties with natural lucidin. The triacetate of (II), lucidin triacetate and a mixture of the two had the same melting point, 175-76°.

We are greatly indebted to Dr. L. H. Briggs for samples of natural lucidin and its triacetate.

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Matunga,      K. VENKATARAMAN.
Bombay-19, *August* 14, 1954.

1. *J. Chem. Soc.*, 1949, 1241.
2. *Ibid.*, 1953, 3068.
3. Mitter *et al.*, *J. Indian Chem. Soc.*, 1928, **5**, 25; 1930, **7**, 259; *Ibid.*, 1930, **7**, 839; Jones and Robertson, *J. Chem. Soc.*, 1930, 1699; Kusaka, *J. Pharm. Soc. Japan*, 1935, **55**, 682.
4. *Bull. Soc. Chim.*, 1936, **3**, 1545.

## 4-HYDROXY-3-ALDEHYDO BENZOIC ACID

DUFF AND BILLS[1] could not isolate any product by the action of hexamine on *p*-hydroxy benzoic acid. Recently Seshadri and Thiruvengadam[2] prepared 5-aldehyde of vanillic acid by this method. Hence the action of hexamine on *p*-hydroxy benzoic acid and its ethyl ester has now been reinvestigated. They yield the 3-aldehydes (I) in 30 per cent. yield. The position of the aldehyde group is established by oxidation with alkaline hydrogen peroxide to protocatechuic acid in 80 per cent. yield.
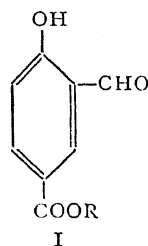


I

*a*, R = H
*b*, R = C₂H₅

*4-Hydroxy-3-aldehydo benzoic acid (I a)*

*p*-Hydroxy benzoic acid (3 g.) and hexamine (12 g.) were dissolved in glacial acetic acid (20 ml.) and heated on a boiling water-bath for six hours. Boiling hydrochloric acid (1 : 1, 30 c.c.) was then added and the heating continued for half-an-hour. The solution was diluted with water and left in refrigerator for 3-4 days. The aldehyde that separated out crystallised from dilute alcohol as pale yellow small prisms, m.p. 232-34°; yield 1 g. (Found : C, 58·1; H, 3·7; $C_8H_6O_4$ requires C, 57·8; H, 3·6 per cent.)

*Ethyl-4-hydroxy-3 aldehydo benzoate (I b)* was prepared in the same way by the action of hexamine (12 g.) on ethyl-*p*-hydroxy benzoate (3 g.) in glacial acetic acid medium (20 ml.). It crystallised from hot water containing a few drops of alcohol as pale yellow long needles, m.p. 104-06°. Yield (1·1 g.) (Found : C, 62·1; H, 5·2; $C_{10}H_{10}O_4$ requires C, 61·8; H, 5·1 per cent.) It gave a deep brown colour with ferric chloride and showed a sky-blue fluorescence in sodium carbonate solution. The 2, 4-dinitrophenyl hydrazone crystallised from glacial acetic acid and melted at 272-73°. The ester, when hydrolysed by heating with dilute sodium hydroxide solution gave I *a*; m.p. 232-34° undepressed by sample obtained as above.

*Protocatechuic acid (II)*

4-Hydroxy benzoic acid-3-aldehyde (1 g.) was dissolved in sodium hydroxide (N. 10 ml.) and to the cooled yellow solution (10-15°), hydrogen peroxide (6 c.c., 6 per cent.) was added dropwise during the course of half-an-hour. It was then allowed to stand at room temperature for 3 hours with occasional shaking, acidified with dilute hydrochloric acid and the product crystallised from hot water, yield 0·8 g., m.p. 194° undepressed by an authentic specimen of protocatechuic acid.

Our thanks are due to Prof. T. R. Seshadri for his kind interest in this work, and to Dr. S. K. Mukerjee for microanalysis.

Chemistry Dept.,          V. K. AHLUWALIA.
Delhi University,          V. V. S. MURTI.
Delhi-8, *June* 2, 1954.

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## THE ANATOMY AND MODE OF ACTION OF THE HEART OF FROG *RANA TIGRINA* DAUD.

THE frog has formed the subject of a series of investigations since the beginning of modern Zoology. The European species *Rana esculanta* (Gaupp[1]) and *Rana temporaria* and the American species *Rana pipiens* (Holmes[2]) have been carefully investigated. The Indian species have not been properly worked out.

In the present study, the heart of *Rana tigrina* Daud. has been selected for detailed investigation. It is a type prescribed for study in the majority of the Indian and Pakistan Universities and also in other neighbouring countries. The study is likely to throw light on the age-old controversy about the distribution and circulation of blood in the heart and the *Truncus arteriosus*.

Some new facts noted are : (1) the arterial type of structure of pulmonary veins, (2) the presence of a new chamber, the *Recessus pulmonalis* (Sharma[3]), (3) the presence of valves between the anterior venae cavae and the *Sinus venosus*, (4) the extension of the *Septum atriorum* beyond the atrio-ventricular cavity into the ventricle and its attachment to valves, (5) the origin of the *Truncus arteriosus* from the *right dorsal* surface of the ventricle, (6) the division of the ventricular cavity into *five* spaces, (7) the origin and disposition of the valves, *four* and not three in number, at the opening of the ventricle into the pylangium, (8) the origin, disposition, and hinge-like attachment of the *spiral valve*, with its double hammer-headed top heavy head which adpresses

the pad-like valve mentioned for the first time, (9) the extension of the spiral valve at its distal end into *two* cup-shaped valves instead of one, (10) the guarding of the systemo-carotid and the pulmo-cutaneous passages each by a pair of valves ; thus the synangium containing four and not three valves, (11) the joint origin of the systemo-carotid arches, and (12) extension of the synangium into a short but distinct region, the *geminangium*, and the disposition of the arches.

The 'classical hypothesis' and the 'complete mixture' theory do not hold good on the basis of the above anatomical facts and the conclusion drawn is, that the systemic and the carotid arches receive the same stream from the left auricle, and if at all, there is some mixture, it is small, and this is so, perhaps when the right stream is followed by the left, which takes a longer route through the central cavity.

Further work is in progress and a detailed study will be published elsewhere soon.

Birla College of Science,　　　H. L. SHARMA.
Pilani, *August 7, 1954.*

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## CONSTITUTION OF CORCHORIN, A BITTER PRINCIPLE OF JUTE SEEDS

TSUNO[1] first reported the occurrence of a bitter principle, corchorin, in jute seeds (*Corchorus capsularis*, L.) but it was Sen[2] who isolated it from the alcoholic extract of the seeds in white prisms, m.p. 174-75° C., having an intense bitter taste and properties characteristic of the digitalis group of saponins.[3] According to him, corchorin has the molecular formula, $C_{22}H_{36}O_8$ and when hydrolysed with acid, yields glucose and corchogenin, $C_{16}H_{26}O_3$, m.p. 112-14° C. Soliman and Saleh[4] also isolated corchorin from jute seeds as rhombic prisms, m.p. 175-77° C. (dec.) but they were unable to hydrolyse corchorin with 2 per cent. sulphuric acid or with "varying concentration of hydrogen chloride in dilute alcohol". They assigned to it the formula, $C_{23}H_{32}O_6$ with 0·5 $H_2O$ as water of crystallisation and showed it to be identical with strophanthidin.

For this investigation, corchorin was obtained by a simplified method. Finely powdered jute seeds in batches of 500 g. were extracted with rectified spirit (95 per cent. ethanol). Alcohol was then completely removed under reduced pressure, and the residue digested with boiling water and filtered. From the filtrate corchorin was isolated following Sen's lead acetate method, and crystallised from methyl alcohol as prisms, m.p. 177-78° C. (dec.). Corchorin, thus obtained, contained no water of crystallisation. When hydrolysed with acid, it yielded a mole of glucose (estimated by Benedict's method) and corchogenin, $C_{17}H_{22}O_3$. [Found : C, 73·9 ; H, 8·1 ; Mol. wet. (cryoscopic, acetic acid) 276·4 and (Rast) 273·1. $C_{17}H_{22}O_3$ requires C, 74·5 ; H, 8·0 per cent.. Mol. wt. 274.]

In view of the conflicting observations mentioned above, as regards hydrolysis of corchorin, experiments were carried out independently by two of us (A. A. and A. K.) with corchorin isolated from various samples of jute seeds (both *C. capsularis* and *C. olitorius*). The procedure adopted for hydrolysis was as follows :

To corchorin (1·2 g.), dissolved in about 50 ml. absolute alcohol, was added 2 ml. sulphuric acid (S. G. 1·836) and heated over steam-bath for four hours with reflux condenser. The resulting mixture was then concentrated to about 15 ml. and left overnight after diluting with 10 ml. water, when yellow amorphous corchogenin separated out. After treatment of its alcoholic solution with activated charcoal, corchogenin was finally crystallised from a mixture of ether and ethanol as prisms, which shrank at 84-85° C. and melted at 115-16° C. To the acid solution, left after separation of corchogenin, was added an excess of barium carbonate, the mixture boiled for a few minutes and filtered. The filtrate was extracted several times with chloroform to remove trace of corchogenin. When the filtrate was concentrated, there remained a syrupy liquid, which was converted into osazone, m.p. 204-05° C., benzoate, m.p. 179-80° C. and benzimidazole, m.p. 212-14° C. (dec.). The melting points of these derivatives were undepressed by admixture with authentic specimens prepared from D-glucose.

In the light of these experiments, we find it difficult to accept the view that corchorin does not contain a sugar moiety and that it is identical with strophanthidin.

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Dept. of Chemistry,　　　　ABDUL KHALIQUE.
Dacca University,　　　　　MOFIZUDDIN AHMED.
Pakistan,
*April 7, 1954.*

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## GAMETOPHYTES IN
*BALSAMODENDRON* MUKUL. HOOK.

PRACTICALLY the only embryological work done on Burseraceæ is by Wiger,[3] which was adversely criticised by Mauritzon.[2] Wiger studied five genera, the genus *Commiphora* (= *Balsamodendron*) being also included; the account presented, however, is very meagre.

Before maturation, the microspore mother cells were found to degenerate. The ovary is embedded in the concavity of the erect and cupular disc.

The young ovules originate as hood-like protuberances in which one sometimes many hypodermal archesporial cells develop and before functioning as megaspore mother cells, cut primary parietal cells on the outside which undergo repeated divisions (Fig. 2). At a later
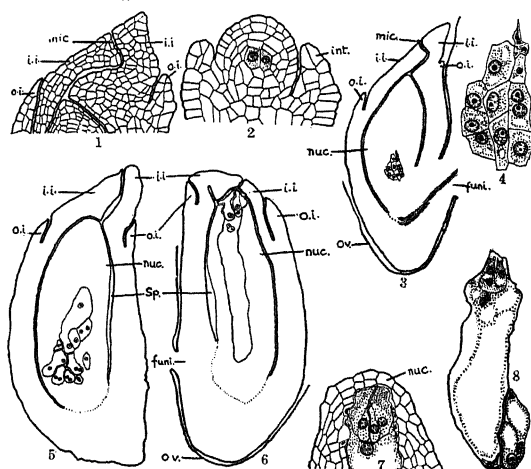


*mic.*, micropyle; *o.i.*, outer integument; *i.i.*, inner integument; *nuc.*, nucellus; *funi.*, funiculus; *OV.*, ovary wall. Sp., Space.

FIG. 1. Upper portion of the ovule showing integuments, S-shaped endostome.

FIG. 2. Two sporogenous cells: note the parietal tissue, divisions in the nucellar epidermis and the single integument.

FIG. 3. Young ovule showing 3 degenerating megaspores just above the young binucleate embryo sac, the rest appear to be embryo sac mother cells.

FIG. 4. Same magnified.

FIG. 5. Ovule showing a number of one and two-nucleate embryo sacs; a two-nucleate embryo sac enlarging.

FIG. 6. Mature ovule, the synergids have digested the nucellus, are lying at the base of the micropyle in contact with the inner integument.

FIG. 7. Upper portion of the nucellus showing the egg-apparatus and the secondary nucleus. The synergids active in corroding the nucellus.

FIG. 8. Mature polygonum type of embryo sac: note two degenerating embryo sacs at the foot.

stage therefore, the megaspore mother cell or cells are found to lie rather very deep in the nucellus. The nucellus thus, is mostly parietal in origin. The nucellar epidermis also shows divisions and contributes to the nucellus (Fig. 2).

There is only one integument in the beginning (Fig. 2) but the outer integument originates soon afterwards. Wiger observed only one integument. The inner integument grows faster and forms an endostome which is S-shaped (Fig. 1), the apex of which protrudes into the style. The outer integument does not take part in the formation of the micropyle. The inner integument and the nucellus are free (Figs. 5, 6).

The megaspore mother cell undergoes usual meiotic divisions to form a linear tetrad of megaspores. Occasionally there are many tetrads in the same nucellus and quite commonly more than one embryo sac mother cell begin to develop simultaneously giving rise to a number of uni-, bi- (Figs. 3, 4, 5) and tetra-nucleate embryo sacs. In such cases, however, usually only one embryo sac survives. Fig. 8 show two degenerating embryo sacs at the foot of the mature embryo sac.

The mature embryo sac conforms to the general organization seen in 8-nucleate embryo sacs (Fig. 8), Maheshwari.[1] The embryo sac corrodes the nucellus in almost all directions. Antipodals are ephemeral. The synergids frequently show frothy protoplasm (Figs. 6, 7). In Fig. 6 the synergids have also approached upwards reaching at the base of the micropyle.

I am indebted to Prof. B. Tiagi for guidance and to Principal V. V. John and Dr. I. M. Rao of Agra College, for encouragement and assistance.

Dept. of Botany, R. D. SHUKLA.
Govt. College, Ajmer,
*July* 8, 1954.

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## A NEW BOTHRIOCEPHALID PARASITE
(CESTODA) FROM THE GUT OF THE
FISH *SAURIDA TUMBIL* (BLOCH)

IN the course of his studies on helminth parasites from food fishes of Waltair coast, the author found that the common fish *Saurida tumbil* (Bloch) harboured adult cestodes. While cestodes in marine fishes of India have been investigated by various workers,[2,4-7] the only previous record of the occurrence of an adult cestode in a marine teleost is that of

Shipley's account[4] of *Bothriocephalus histiophorus* from the Sword-fish *Histiophorus* sp. Woodland[9] described *Bothriocephalus pycnomerus* from the fresh-water fish *Ophiocephalus marulius* at Allahabad. Ganapati and Rao[1] recorded a third species, *Bothriocephalus indicus* n. sp., from *Saurida tumbil* (Bloch).

The present form also from the same host *Saurida tumbil* (Bloch) is a gut parasite. While the environment of the strobilar phase of all tapeworms excepting *Stilesia* and *Thysanosoma* is the small intestine of vertebrates (Wardle and McLeod[8]), the present parasite is peculiar in that its scolex is embedded in liver while its strobila lies free in the lumen of the intestine. In *Stilesia* and *Thysanosoma* the entire worm lies in the bile duct. The liver cells around the scolex of the present form become necrotic and finally get replaced by fibrous tissue (Fig. 1). An adventitious cyst
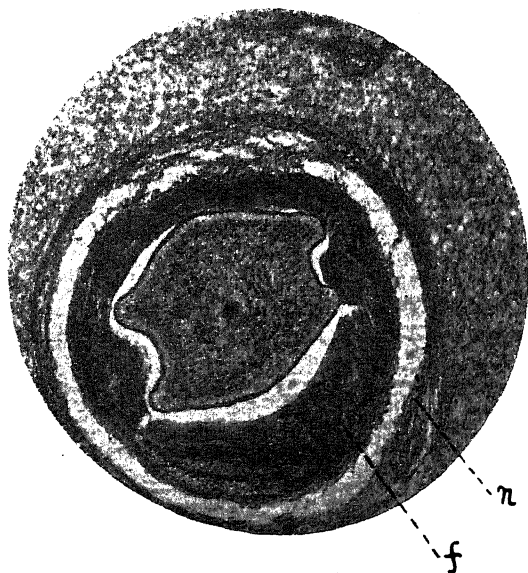


FIG. 1. Section of liver showing necrotic cells (*n*) and fibrous tissue (*f*) around the scolex.

wall is thus developed which envelops the scolex. In some cases the scolex may even undergo degeneration and what remains is a coiled mass lodged in a cyst (Fig. 2) buried in the liver.

While it is possible for the worms, owing to the extreme slenderness of the anterior region of the strobila, to get into the liver through the bile duct, it is curious that they prefer to enter the body cavity piercing the intestinal wall and reach the liver. In the young infected fish, parasites with free scolices have been observed in the body cavity, just below the liver, as well as forms where the scolices have just invaded the liver.

It is obvious that in the infected fish the parasites in addition to causing mechanical obstruction to the free passage of food through the intestine, also damage the liver by their penetration and attachment to the latter organ.
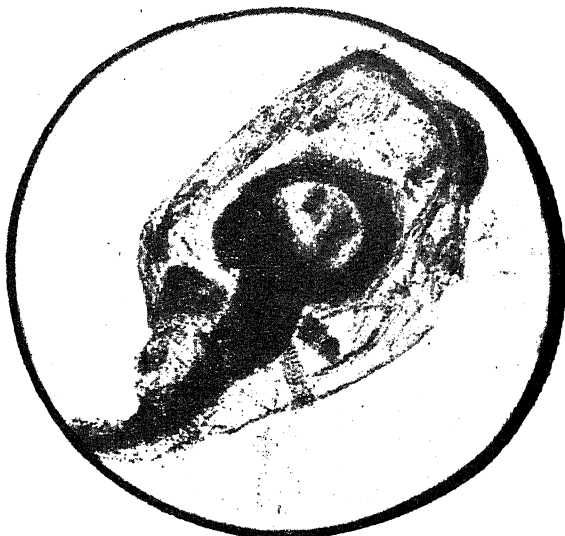


FIG. 2. Coiled anterior region of the parasite in cyst.

The present form does not agree with any of the Bothriocephalid species described by Yamaguti[10] and Linton.[3] Hence it appears to be new and is named as *Bothriocephalus ganapattii* sp. nov.

Further work on this form and the histopathology of the host's tissue are in progress.

I wish to express my grateful thanks to Professor P. N. Ganapati, for his kind help and encouragement.

Dept. of Zoology,      K. Hanumantha Rao.
Andhra University, Waltair,
*June* 10, 1954.

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## A RECORD OF MALLOPHAGAN PHORESY BY *PSEUDOLYNCHIA MAURA* (DIPTERA, HIPPOBOSCIDAE)

THERE are records of Mallophaga having been carried from one host to another through the agency of Hippoboscid flies. Lense[1] coined the word 'phoresie' for this act of mere mechanical transference of one insect on the body of another larger one, without its feeding on the latter. Since then, this term has been adopted by several workers in the form of 'phoresy'.

Clay and Meinertzhagen[2] were the first to summarize all the published records of Mallophagan phoresy by Hippoboscid flies. They observe that the act takes place on the bird-host and the Mallophaga concerned belong to the genera *Philopterus* and *Briüelia*. Subsequently, Hopkins[3] made an interesting record indicating that the members of *Amblycera* are similarly implicated in cases of phoresy and the louse concerned is *Menacanthus gigenteus* (Denny). Ansari,[4] during his study on Mallophaga from birds of the Punjab, came across two examples of phoresy between a Mallophaga and Hippoboscidæ, and stated that the transport of Mallophaga by the bird-flies is purely accidental and not a common feature. From the available records, it is ascertained that the Hippoboscide concerned are species of *Ornithomyia*, *Ornithoica* and *Lynchia*. The locations most favoured by the louse are usually the wings, legs or abdomen; the attachment is by the mandibles around the roots of hairs or veins of wings but not by embedding themselves into the abdominal wall of the fly,

Recently we came across a case of phoresy, which appears to be the second of its kind from India. The Hippoboscid was found on the wall of a house in Bombay, during the early hours of 12th February 1954. On examination it turned out to be *Pseudolynchia maura*, a hippoboscid, commonly found on pigeons (*Columba livia*), kites (*Milvus migrans govinda*) and crows (*Corvus* sp.), in this part of the country. At the same time, it was interesting to notice a Mallophaga, one of the Ischnocera, firmly attached to the right side of the abdomen of the fly by means of mandibles and legs. As it was desired to preserve the specimens intact, it was not possible to ascertain whether the mandibles were embedded in the abdominal wall or simply attached to the roots of hairs. For the same reason, the specific identity of the louse could not be determined.

The detection of Hippoboscid away from the body of the host throws further light on the evidences of the possible transmission of lice from host to host through the agency of flies. The specimens were sent to Miss Theresa Clay of British Museum, who identified the louse, a female, as a species of *Brüelia*, belonging to the group found on the members of the Corvidæ, probably *Corvus* species. This record is of importance as it reveals another case of *Brüelia* being involved in phoresy, and also that the host is parasitic on Corvidæ, if this is not already known.

Bombay Veterinary College, L. S. HIREGAUDAR.
Bombay, *June* 27, 1954.     F. S. KHAMBATA.

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## INCIDENCE OF INFERTILITY UNDER VARIOUS CAUSAL GROUPS IN BUFFALO COWS IN INDIA

THE buffalo holds an important position in the dairy industry of this country. It is therefore a matter of surprise that this useful animal has received such scanty attention from workers in the field of physiology and pathology of reproduction, especially since disorders of reproductive functions effect the productivity of the animal so adversely. No information regarding the causes of infertility and its incidence under various causal groups in buffaloes is available excepting a few cases mentioned by Polding and Lall.[1] Studies in this direction have been taken up at this Institute in recent years. As a part of these investigations, examination of the genital organs from the female buffaloes destroyed at the Bareilly abattoir was made. Personal enquiries made from the owners of these animals revealed that the animals found their way to the slaughter house as they were considered to be infertile.

Out of 1020 genital organs examined, 100 (9·8 per cent.) were from heifers. Out of 920 specimens of genitalia from adult buffalo cows, 150 (16·3 per cent.) were found to be in gravid condition. The stage of pregnancy in majority of cases (90, per cent.) varied between 4-14 weeks. It may be mentioned here that at this early stage it would be difficult for laymen to know that the animals are in pregnancy. The incidence of defects and disorders of various types found in 770 adult buffalo cows and 100 buffalo heifers are given in Table I. Total ovarian hypoplasia has been reported in foreign

TABLE I

| Types and sites of disorder | Buffalo cows | | Buffalo heifers | |
|---|---|---|---|---|
| | Unilateral % | Bilateral % | Unilateral % | Bilateral % |
| OVARIAN BURSA | | | | |
| 1 Adhesions | 4·16 | 10·91 | 3·00 | 11·00 |
| 2 Hydropsii bursa | 0·52 | 0·13 | ·· | ·· |
| 3 Lymphoids | ·· | 3·90 | ·· | ·· |
| MESOSALPINX | | | | |
| 1 Cysts | 2·38 | 0·39 | 2·00 | 1·00 |
| FALLOPIAN TUBES | | | | |
| 1 Salpingitis | 0·78 | 0·13 | ·· | ·· |
| 2 Hydrosalpinx | 1·04 | 0·65 | 2·00 | 1·00 |
| 3 Pyosalpinx | ·· | 0·13 | ·· | ·· |
| 4 Blind fallopian tube | 0·13 | ·· | 1·00 | ·· |
| OVARIES | | | | |
| 1 Oöphoritis | 6·10 | 2·21 | 3·00 | 4·00 |
| 2 Encapsulation | 2·34 | 0·78 | ·· | 3·00 |
| 3 Fibrosis | 4·16 | 0·78 | 5·00 | 1·00 |
| 4 Dermoids | 0·78 | 0·13 | ·· | ·· |
| 5 Subactive condition | 2·73 | 5·97 | 2·00 | 6·00 |
| 6 Hæmatoma | 1·43 | ·· | ·· | ·· |
| 7 Luteinised follicles | 0·52 | ·· | ·· | ·· |
| 8 Cysts | 3·77 | 0·65 | ·· | ·· |
| 9 Persistent corpus luteum | 2·08 | ·· | ·· | ·· |
| UTERUS | | | | |
| 1 Metritis | 27·15 | | 11·00 | |
| 2 Parametritis | 4·72 | | ·· | |
| 3 Internal adhesions | 0·13 | | ·· | |
| 4 Hydrometra | 1·56 | | 5·00 | |
| 5 Pyometra | 0·52 | | 4·00 | |
| 6 External cysts | 1·69 | | ·· | |
| 7 Lymphoids | 4·68 | | 1·00 | |
| 8 Atonicity | 3·12 | | 4·00 | |
| CERVIX | | | | |
| 1 Cervicitis | 10·52 | | 1·00 | |
| 2 Adhesions | 0·26 | | 1·00 | |
| 3 Cysts | 0·39 | | ·· | |
| VAGINA | | | | |
| 1 Vaginitis | 11·69 | | 5·00 | |
| 2 Occlusion in vagina | 0·39 | | 1·00 | |
| Disturbed endocrine balance* | 6·10 | | 6·00 | |

\* As judged from the abnormal condition of Graffian follicles and corpus luteum.

literature, but no such case has been detected in the specimens examined by us. The incidence of metritis and cervicitis is quite high in adult animals. It is intended to publish the results of the entire investigation in detail elsewhere.

Animal Genetics Division,    P. BHATTACHARYA.
Indian Vet. Res. Inst.,    S. N. LUKTUKE.
Izatnagar, U.P., India,    A. S. P. RAO.
*June* 12, 1954.    S. K. DE.

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## POST-EMBRYONIC DEVELOPMENT OF TESTES IN SUBFAMILIES GALERUCINAE AND ALTICINAE OF THE FAMILY CHRYSOMELIDAE (COLEOPTERA)

THE testes adopts a mesial position in the form of median organ joined posteriorly with lateral ejaculatory ducts through a pair of vasa deferentia in the subfamilies Galerucinæ and Alticinæ of the family Chrysomelidæ (Fig. 1). While studying the post-embryonic development of the male reproductive organs in *Galerucella birmanica* Jac. the author observed that, in the larval (Fig. 2) and pupal (Fig. 3)
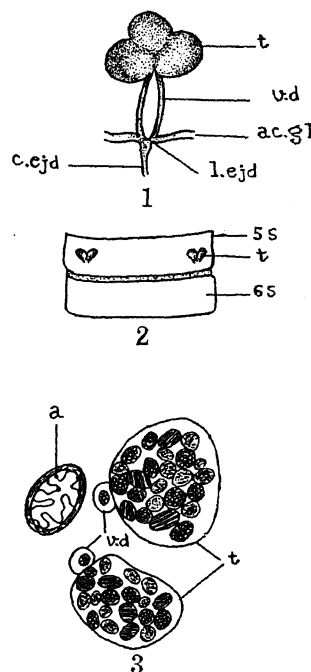


FIG. 1. Male reproductive organ of *G. birmanica*, × 11.
FIG. 2. Larval segments showing testes, × 10.
FIG. 3. Transverse section of pupa showing testes, ×54. *a*—alimentary canal; *ac. gl.*—accessory gland; *c.ejd.*—common ejaculatory duct; *l. ejd.*—lateral ejaculatory duct; *s.*—sternite; *t.*—testes; *v.d.*—vas deferens.

stages, the testes maintain their paired existence, each connected with separate vas deferens like other species of Coleoptera including the remaining subfamilies of Chrysomelidæ but as the maturity of pupa advances the two testes drift mesially, uniting ultimately before the emergence of imago to form a median testis which is distinctly lobed. The reason for their coalescence is still a mystery in these two subfamilies which are phylogenetically interrelated, and is being worked out.

Section of the Entomologist    B. K. VARMA.
to Govt., Uttar Pradesh,
Kanpur, *June* 22, 1954.

# REVIEWS

**The Origin of the Earth.** By W. M. Smart. (Cambridge University Press), 1953. Pp. vi + 239. Price 18 sh.

Professor W. M. Smart is a distinguished scientist, who has to his credit many advanced books on astronomy and astrophysics. It is not surprising therefore that in his attempt to deal with the origin of the earth, he has presented a very popular and lucid and at the same time authoritative account of the latest advances not only in astronomy but in the physical and geological sciences as well.

Dividing the subject into three parts, "whence", "when" and "how", the author has examined the various theories in the past and those made in recent years and has, with a good deal of caution, come to the following tentative conclusions. There is good evidence, the author says, to assert that the earth and the whole solar system is derived from a single activity on a great scale in the distant past, though there is still some doubt whether this activity was in the sun or in some unknown star—which would then be the parent of the whole solar system. Also, the age of the solar system and that of the earth can be placed to lie between 3,000 and 4,000 million years. The author has, however, left the last query as to how the earth came into being as a problem still awaiting a correct solution, since all the theories proposed up to date fail to carry conviction.

The book is quite readable and very popular in its treatment of advanced topics in astronomy. It can be read with great profit by non-astronomers as well.

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**On the Congruence of Sets and Their Equivalence by Finite Decomposition.** By Waclaw Sierpinski. (Lucknow Univ. Studies, No. XX), 1954. Pp. 117. Price not given.

This study by Professor Sierpinski gives a very readable and interesting account of congruence of sets and equivalence by finite decomposition, mainly for sets in Euclidean spaces of 1, 2 or 3 dimensions. Congruence is defined as an isometry between subsets of a metric space. Any two subsets A, B which can be partitioned into the same finite number ($n$) of mutually disjoint subsets $A = \Sigma A_i$ $B = \Sigma B_i$ so that $A_i$ and $B_i$ are congruent for

each $i$, are said to be equivalent under finite decomposition (into $n$ parts). Typical results are :

There is a linear set (*i.e.*, subset of the Euclidean line) and an enumerable family of mutually disjoint linear sets such that any linear set superposable by translation with E belongs to the family ; and the linear set cannot be Lebesgue measurable. The straight line is equivalent by decomposition into two parts to the set obtained by retraction of any enumerable set from the line. A rectangular isosceles triangle is equivalent to a square by finite decomposition. There exists a plane set which is the sum of two disjoint sets each congruent to the square. But a linear set cannot have such a paradoxical resolution (into disjoint subsets equivalent to the whole by finite decomposition). A segment of a straight line is not equivalent by finite decomposition to any smaller segment. A solid sphere is equivalent under finite decomposition to two disjoint spheres of the same radius. Any two bounded sets in three dimensional space are equivalent by finite decomposition if each of them contains a solid sphere. Any circle S is smaller by finite decomposition than any circle S', *i.e.*, S and S' can be partitioned into the same finite number ($n$) of disjoint subsets $S = \Sigma A_j$ and $S' = \Sigma B_i$ such that for each $i$ there is a biunivocal mapping of $A_i$ in $B_i$ which diminishes distances.

V. S. KRISHNAN.

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**A Treatise on Applied Hydraulics.** Fourth Edition. Revised and Enlarged. By Prof. Herbert Addison. (Chapman & Hall), 1954. Pp. vii + 724. Price 56 sh.

Students of hydraulics need no introduction to Addison's classical work on Applied Hydraulics. It is well known that every development in fluid mechanics that takes place in the numerous richly endowed aerodynamic laboratories either adds directly to our knowledge of hydraulics or opens out a new field of investigation. As the volume was published twenty years ago a revised edition embodying the latest developments in the field is a welcome addition to the literature on the subject.

In the present edition, the original style of presentation has been maintained. Considerable

matter that is new has been added. More information on hydrodynamics, particularly in regard to the properties of irrotational motion and conformal mapping, are necessary to understand the recent developments in the design of propellers and runners. While discussing turbulence Von Karmen's theory may have also been included. It is hoped that these will be added in the next edition of this standard work on applied hydraulics.

N. S. GOVINDA RAO.

**Rocket Propulsion.** Second Edition. Revised. By Eric Burgess. (Chapman & Hall, Ltd.), 1954. Pp. 228. Price 21 *sh.*

The book introduces the reader to the subject of rocket propulsion, setting out the basic principles of rocket dynamics—jet flow, thrust, specific consumption of a rocket motor, propulsive efficiency, mass ratio, etc. After an interesting account of solid and liquid fuels with their compositions useful for signal rockets and fireworks, military projectiles, fluid missiles, etc., the characteristic properties necessary for an ideal rocket propellant are deduced. The engineering details of the combustion chamber, the rocket nozzle for an ideal velocity and various methods of fuel cooling in regenerative systems for increasing the thermal efficiency of the motor are very elegantly described. The author is of the opinion that no existing basic motor design theory is suitable for a rocket motor, and it is only trial and error in future research that must establish a fundamental rocket motor theory. Problems of fuel feed and fuel tanks for various types of rocket motor with illustrations are given. The chapters on control of flight, long range rocket projectiles, the rocket and the interplanetary travel and the use of atomic energy for rocket propulsion to the moon are presented in a fascinating way not only for the layman but also to engineers, physicists, chemists, etc.

Though there is no fundamental difference in structure between the old and revised editions, yet the author has endeavoured to bring the latter up to date by additional details here and there. A section on expendable construction, its effective mass ratio and data on the possible use of instrumented probes for deep space research is given in the revised edition.

All those who might lay their hand on this book will read it with absorbing interest, for, who would not be interested in the story of man's age-old dream of journey to the moon—

especially when it is told in such an admirably simple style as the author has done?

M. SANTHAPPA.

**The Chemistry of Heterocyclic Compounds.** Edited by A. Weissberger. Compounds with Condensed Thiophene Rings. By H. D. Hartough and S. L. Meisel. (Interscience Publishers), 1954. Price $16.50.

The literature on condensed systems containing a thiophene ring is so voluminous that a volume separate from *Thiophene and Its Derivatives* has had to be devoted to it. As in earlier volumes of the series compounds of each type are listed in tables, together with their physical constants, reaction conditions, yields and other data. The original draft of the book was completed in May 1951, but some references up to May 1952 have been included. Chapter I deals with factors influencing chemical reactivity and substitution of thiophene systems, and Chapter II with thianaphthene and other thiophene compounds containing one carbocyclic fused ring. Chapter III on thioindigo and related dyes is the least satisfactory part of the book. The chapter begins with the amazing statement: "The isosteric relationship between indigo and thioindigo dyes was responsible for the rapidity with which the thioindigo dyes reached commercial importance.." Information from Colour Index (1924) is reproduced, and valuable space is wasted by presenting the umbrella and tower formulæ for indigo before proceeding to the accepted structure. It is claimed that the discussions in this chapter are from "an academic viewpoint", but it is difficult to see why such a viewpoint should exclude technically important dyes and their syntheses, or why it should include a list of patents on thioindigoid dyes running into ten pages. The term "dye composition" is used erroneously for dyes. In the reference to nitrobenzene (p. 186) it is forgotten that this solvent is also an oxidizing agent. There is a useful summary of the work of S. K. Guha, P. C. Dutta and others on empirical relationships between colour and constitution in the thioindigoid series.

Chapters IV and V describe dibenzothiophene, naphthothiophenes, and their derivatives. Chapters VI, VII and VIII, dealing with thiophene systems containing three or more carbocyclic fused rings and with condensed thiophones containing O, S, Hg and N ring systems, are particularly interesting and suggest many problems for research.

The book as a whole is somewhat disappointing. It will be useful for reference, but parts of the book are difficult to read and give the impression of being merely an elaboration of the Ring Index.

Several errors have been noticed and examples are the formula for isothianaphthene (p. 167); quindoline is not the "pyridine isostere" of compound (I) in p. 435; the resonance indicated in p. 318 is contrary to substitution reactions (*e.g.*, bromination) of dibenzothiophene; the structure assigned by Eistert (*Ber.*, 1947, 80, 47) to the condensation product of 3-hydroxythianaphthene and 2 : 3-dichloro-1 : 4-naphthoquinone has not been mentioned ; the compound, m.p. 209°, mentioned in p. 386 has been shown by Baker (*J. C. S.*, 1952, 3163) to be dibenzothiophthene ; in p. 387, line 2, "1, 5-bis" should read as "2, 6-bis"; the paragraph in p. 374 commencing with "The structure of I" needs to be rewritten.

<div align="right">K. V.</div>

Spot Tests, Part II. (*Organic Applications.*) By Fritz Feigl. (Elsevier Publishing Co., Ltd.), 1954. Pp. xv + 436. Price 37 *sh*. 6 *d*.

The volume under review is an inspiring record of years of careful work by the author. An excellent case has here been made for the use of spot tests as an elegant method in the identification of intermediates and final products.

The seven chapters comprising the book lead the reader through all the stages of a thorough study of the subject. The chapter on equipment and techniques is contributed by Dr. Ph. W. West whose contributions in the field of microchemistry are well known. It would be highly profitable for students and instructors alike to master the two chapters (pages 50 to 232) and to remember that the correct identification of a functional group, corresponding to testing for cationic and anionic constituents in inorganic analysis, can be achieved only by a careful process of direct and indirect tests. Full instructions are given, following which one should be able to do the work quickly and correctly. Chapter 5 deals with the characteristics of 51 individual substances. Any instructor, who is able to take his class through these compounds, can be sure that he has imparted the best training.

The chapter on applications of spot reactions for technical and scientific purposes is more in the form of an introduction than a full course treatment. It opens out the way for interested

persons to employ spot-testing to solve everyday problems that arise in analytical and technical laboratories. The tabular summary of the limits of identification attained by spot tests gives a lot of essential information ready at hand.

The author and the translator deserve the best thanks of every student of organic chemistry for making available such a very useful book in English. The reviewer hopes that spot tests would be more widely used in laboratories in the near future. 'Spot tests' by Feigl should be on the shelf of every laboratory.

<div align="right">K. N. MENON.</div>

Organic Peroxides. By Arthur V. Tobolsky and R. B. Mesrobian. (Interscience Publishers), 1954. Pp. x + 197. Price $ 5.75.

The volume under review deals with the preparation, properties and structural classification of various types of organic peroxides, extensive literature citations being included. Peroxides with the structures, $ROOH$ or $R_1OOR_2$ where the R's may be alkyls or aryls, transannular peroxides of sterol, anthracene, naphthalene, etc., aliphatic and aromatic peroxy acids, peroxy esters, diacyl and diaroyl peroxides, etc., are briefly described with their preparation, properties and other relevant details. An organic chemist engaged in the preparation of organic peroxides and high polymer chemistry will find the details of various methods, chemical and physical, of estimation of various types of peroxides very handy and useful.

Eleven diagnostic tests for the detection of radicals from the decomposition of peroxides are described. Various steps in the thermal and photochemical decomposition of ditertiary butyl peroxide in vapour phase and in various solvents and the kinetics of spontaneous and induced decomposition in solvents of benzoyl peroxide have been dealt with at great length. The decomposition, in the presence of solvents of various peroxides leading to the setting up of chains, the ferrous ion induced decomposition of peroxides, the homolytic and heterolytic cleavages of the peroxides, etc., have been very instructively surveyed. The last chapter of the book contains details about the peroxides as catalysts and initiators of vinyl polymerization, with a brief description of elementary steps and kinetics of vinyl radical polymerization.

Chemists engaged in radical polymerization of vinyl monomers will find this book highly useful and interesting. The scattered data about the properties of peroxides especially as initiators

of polymerization have been collected and collated here for the first time and therefore the volume will prove a boon to high polymer chemists.

M. SANTHAPPA.

Methods of Biochemical Analysis. Vol. I. Edited by David Glick. (Interscience Publishers), 1954. Pp. x + 521. Price $ 9.50.

So many different methods of assay of biologically important substances and systems have been reported in scientific literature that one often finds it difficult to choose the best and the most authoritative among them. The volume under review is the first of what is designed to be an annual series publication, with the object of collecting together methods and techniques, which can be relied upon and which lay emphasis on recent developments. The selection of topics has been somewhat arbitrary, and one fails to see much of a connection between one topic and another, except perhaps, the broad classification under chemical determinations, paper chromatography, autoradiography, zone electrophoresis and ultracentrifugal analysis. But as this annual series is intended to be an encyclopedic treatment of various methods of biochemical analysis by experts in the respective fields, one may rely on Editor Glick and his internationally renowned advisory board for the judicious selection of topics, which will be of current importance every year.

The present volume deals with biochemical methods such as determination of sulfhydryl groups and phenolic compounds, microbiological assay of antibiotics and vitamin $B_{12}$, chemical determination of choline, and ascorbic acid, separation of steroids of the adrenal gland, assay of urinary neutral 17-ketosteroids, chromatographic analysis of radioactive iodine-compounds from the thyroid gland and body fluids, estimation of nucleic acids and determination of raffinose and ketose in plant products, as also the assay of catalases, peroxidases and hyaluronidase and the determination of adenosine triphosphate and related compounds, by firefly luminescence and other methods. In the treatment of each method there is generally a discussion of the background of previous work, and a critical evaluation of the existing procedure followed by a detailed description of the procedure recommended given in such a manner, that it will give complete information necessary to carry out the analysis. In some chapters, the exact

manner in which special equipment can be rigged up have been given in detail. The volume on the whole should prove extremely valuable to all biochemists who are constantly faced with the problem of choosing the best method or technique in their research work. It should also find a place in the libraries of all institutions interested in research or the teaching of biochemistry.

P. S. SARMA.

Electro-Analytical Chemistry. By James J. Lingane. (Interscience Publishers, Inc.), 1953. Pp. ix + 448. Price $ 8.50.

This volume covers the wide range of subjects which can be included under the comprehensive title, "Electroanalytical Chemistry", the only notable omission being polarography. The existence of authoritative monographs on polarography provides the author with sufficient justification for its non-inclusion in this volume. For the same reason the practical aspects of analytical methods such as conductometry, pH measurements and potentiometric titrations do not receive the detailed treatment that they merit. In the chapters devoted to these subjects (IV to IX) the emphasis is more on the theoretical basis of these methods. The stress laid on the fundamental aspects of electrochemistry is a welcome feature of this book. Thus two chapters, II and III, are set apart for a consideration of the fundamentals such as electrical units and standards, measurement of E.M.F. theories of E.m.F., etc. Similarly Chapter X entitled "Electrolysis" deals with all aspects of that subject in detail. In Chapters XI to XVIII, one finds a highly informative account of the methodology and the specialized technique employed in electro-gravimetric analysis, internal electrolysis, electrographic analysis and coulometric analysis. Automatic instrumentation as described in Chapter XI has considerably enhanced the value of electro-gravimetric analysis, and the fact that the author has devoted three chapters (XII, XIII and XIV) to this subject is an index of the growing recognition of the importance of this somewhat neglected branch of electro-analysis.

Special attention should be drawn to the last two chapters (XVII and XVIII) which deal with the newest of all electrometric techniques —coulometric analysis in which the quantity of electricity required for a quantitative reaction is measured either by a coulometer or obtained by multiplying time with the constant cur-

rent employed for electrolysis. This is the first time that this subject finds its due place in a monograph.

A standard treatise on the subject, the volume must find a place in every analytical library. The format maintains the excellent standard of other Interscience publications.

A. P. MADHAVAN NAIR.

The Biochemistry of Brewing. By I. A. Preece. (Oliver & Boyd), 1954. Pp. 393. Price 25 *sh.* net.

The burden of maintaining contact with new developments in all aspects of biochemistry is indeed heavy today even for a professional bio-chemist. This burden falls all the more heavily on the industrialist interested in interpreting the observations made in the laboratory on the scale obtaining in the brewery, for instance. The book under review represents an attempt made by the author to bring together within the scope of a small volume all the useful information available in biochemistry and to apply it in modern biochemical terms to the raw materials and proceses involved in the manufacture of malt and beer. The attempt has been remark-ably successful despite the gaps in our know-ledge of the biochemistry of the raw materials used in the brewing industries.

The book deals primarily with the various steps entailed in the manufacture of good beer, and this would naturally call for detailed dis-cussions on the stability and characters of beer itself, as well as the chemical compositions of the raw materials, the biochemistry of malt-ing, mashing, copper boiling, fermentation and process control. In doing so, the author has not only brought together a large collection of established scientific facts and the practical viewpoints gained through the background of substantial empirical knowledge, but has point-ed the way to the successful exploitation of both by science and industry.

The book is well printed and is remarkably free from errors. It is moderately priced and will be found useful by all interested in fer-mentation industries and biochemistry.

J. V. B.

Intermediate Zoology. By D. R. Puri. (S. Chand & Co., Delhi), 1953. Pp. 441. Price Rs. 9.

This book is adequate for the needs of the Intermediate students for whom it is meant. The author follows the time-honoured type system and starts with the study of the frog. The frog and the prescribed types are dealt with rather fully, and the main groups belong-ing to the rest of the animal kingdom are treat-ed in a general and elementary way. The pre-liminary chapters deal with the basic facts of biology, and the two chapters following the account of the frog deal with histology.

The matter contained in the book and the manner of its treatment are satisfactory. How-ever, in describing the life-cycle of the mala-rial parasite, no reference has been made to the stage when the parasite is in the liver of the human host ; this is a serious omission. The homologies of the parts of the maxilla of the cockroach (page 214) are wrongly given. The emphasis on the so-called diploblastic nature of the Coelenterata and gastrula stage in deve-lopment is out of tune with recent knowledge.

The language is in general simple and clear. There are some statements (like 'Man, for in-stance, was evolved from an ape', page 285; 'There is a gene for every character', page 361) which are misleading and should not find a place in any book, much less in an elementary text-book. There are several spelling mis-takes, the majority of them occurring in techni-cal terms. It is hoped that the next edition will be shorn of these defects.

The book is profusely illustrated, and the illustrations are neat and the parts are directly named in full. An exhaustive glossary of tech-nical terms and an index are added at the end. The get-up of the book is good and leaves no-thing to be desired.

M. E.

Survey of Biological Progress, Vol. II. Edited by George S. Avery Jr. (Academic Press Inc., New York), 1952. Pp. 333. Price $ 7.00.

The first of this series appeared in 1949 with a list of important experimental techniques covering eleven diverse fields of modern bio-logical research such as Genes and Gene Action, Tracer Methods, Growth Hormones, and Eco-logical Studies on Populations. That volume was well received by the research worker as well as the amateur biologist. The present volume covers many other fields of modern biological research such as Effects of Radia-tions on Biological Systems, Progress in Human Genetics, Biological Oceanography, Morpho-genesis in Plants, Plant Hormones, Histochemis-try, Fine Structure of Protoplasm, and Phy-siology of Reproduction in Plants. Whilst the aim of these treatises is mainly to stimulate thinking in the specialist, it has, to my mind, an even greater function—it produces an integ-ration of the different disciplines in science and reveals to the biologist the need for applying fundamental principles of the physical sciences in interpreting biological norm.

This volume has been lavishly produced with many rich illustrations, particularly excellent half-tone blocks of electron micrographs in the chapter dealing with the structure of protoplasm. The bibliography at the end of each chapter is exhaustive in most cases and is printed in alphabetical order, although there appears to be no uniformity in the matter of numbering the citations serially. In the chapter dealing with 'Histochemistry', the reviewer is surprised to find that no mention is made of chromatography among the methods used for its study, although in recent years it has become a vital analytical tool in the hands of biologists.

The overall view that one gets after perusing this book is that it provides specialised knowledge to all experimentalists, particularly experimental biologists. It would, nevertheless, be appreciated by a much wider public, as there is enough material to satisfy their general scientific interests. T. S. SADASIVAN.

**Bibliography of Soil Science and Fertilizers with Reference to India.** By K. K. Guha Roy. (Issued as *Bulletin No. 74*, by I.C.A.R., New Delhi), 1954. Pp. iv + 131. Price not given.

The author who was formerly Librarian, Linlithgow Library, Indian Agricultural Research Institute, New Delhi, points out in his preface that in regard to the scientific study of soil and crops in India, the Imperial Bureau of Soil Science have been rendering signal service. But they started with the year 1931 leaving out the references previous to that date, and much information contained in the annual reports issued by the various Departments of Agriculture which are regarded as very valuable is not included in their purview. The author therefore undertook to compile a consolidated bibliography of all literature pertaining to India on soils and fertilizers so that the Indian research workers in this field might be aware of what has been achieved and what remains to be achieved. With this end in view the compilation of this bibliography was undertaken about 4 years ago, and has now been brought up to the end of 1942. The *Bulletin* is bound to be highly useful to workers on soil science and agriculture in India.

**Books Received**

*Text-Book of Metallurgy.* By A. R. Bailey. (Macmillan & Co.), 1954. Pp. viii + 560. Price 30 *sh.*

*Semi-Micro Organic Preparations.* By J. H. Wilkinson. (Macmillan & Co.), 1954. Pp. x + 94. Price 8 *sh.* 6 *d.*

*Outlines of Organic Chemistry.* By E. J. Holmyard. (Edward Arnold Pub. Ltd.), 1954. Pp. vii + 492. Price 16 *sh.*

*Introduction to* 3-*D.* By Dewhurst. (Chapman & Hall), 1954. Pp. xv + 152. Price 21 *sh.*

*Statistical Analysis in Chemistry and the Chemical Industry.* By Carl A. Bennett and Norman L. Franklin. (Chapman & Hall), 1954. Pp. xvi + 724. Price 58 *sh.*

*Science and Civilisation in China,* Vol. I. By Joseph Needham. (Cambridge University Press, London), 1954. Pp. xxxviii + 318. Price 52 *sh.* 6 *d.*

*Gas Dynamics of Thin Bodies.* By F. I. Frankl and E. A. Karpovich. (Translated from the Russian by M. D. Friedman.) (Interscience Publishers, Inc.), 1954. Pp. viii + 175. Price $ 5.75.

## EXCHANGE OF SCIENTIFIC INSTRUMENTS

APPLICATION of a scheme to aid the international exchange of delicate scientific measuring instruments was announced on August 25, by UNESCO. Thirty-four Member States of UNESCO have expressed interest in applying the scheme and 19 of them have named a total of over 70 scientific laboratories as participants.

The UNESCO-sponsored scheme is designed to assure speedy and safe transit of scientific measuring instruments, exchanged between laboratories in different countries for purposes of comparison. The scheme involves use of an internationally standardized and recognized label on packages of instruments. With this label, carrying the distinctive UNESCO symbol, packages receive customs clearance at the sending or receiving laboratories rather than at customs depots, thus avoiding possible damage or delay.

UNESCO is to keep a register of laboratories designated by governments as participants and send member States information on its operation. The first information circular was sent on August 25, by the Director-General of UNESCO.

The International Bureau of Weights and Measures and the International Council of Scientific Unions have both endorsed the plan, which forms part of UNESCO's programme for the free flow of information.

# SCIENCE NOTES AND NEWS

### Wheat Culture

Prof. A. B. Saran, Bihar Agricultural College, Sabour, writes as follows:

In an experiment on wheat culture conducted at the College Farm, Sabour, the seeds were sown on ridges about 8" high and 9" apart. An increase in yield of 57·5 per cent. over the local cultural practice (seeds sown behind the plough) was observed. The experiment covered an area of 0·20 acre.

The author got the idea of sowing wheat on ridges from Japan, where he found bumper wheat crop growing on ridges in plots which had a rice crop in the preceding season. Grateful thanks are due to Dr. R. H. Richharia for providing facilities at the College Farm.

### Prefixes for $10^6$, $10^9$ and $10^{12}$

The International Union of Pure and Applied Physics in 1948 made a recommendation for names and symbols for the prefixes $10^6$, $10^9$ and $10^{12}$. In 1951 the recommendation was stressed by a separate resolution at the Copenhagen meeting of the Union and it was repeated by the Conférence Générale des Poids et Measures. The recommended usages were: $10^6 = $ mega; $10^9 = $ giga; $10^{12} = $ tera; $10^6 eV = MeV = $ mega electronvolt; $10^9 eV = GeV = $ giga electronvolt; $10^{12} eV = TeV = $ tera electronvolt.

The Report to the Assembly of the Commission for Symbols, Units and Nomenclature, at the meeting of I.U.P.A.P. held in London during 7-10 July 1954, stated: "Notwithstanding the recommendations, the name BeV is still very much used, in particular by United States scientists, to denote $10^9 eV$, as an abbreviation for 'billlion-electronvolt'. This is very regrettable, not only because there is no reason to write BeV and not GeV, but mainly because of the well-known double meaning which the word 'billion' has: $10^9$ in the United States, and $10^{12}$ in Europe. The prefixes mega, giga and tera, on the other hand, are *not* related to either the European or the United States names of numbers; they are derived from Greek words which mean respectively large, very large and monstrous. It is hoped that, in particular, scientists working in the field of high energy particles and machines will avoid the ambiguous word 'billion' and use the recommended symbols.

### High-Speed Electronic Thermometer

A new electronic clinical thermometer which gives an accurate temperature reading in 5-7 seconds was demonstrated recently at the Army Medical Service Graduate School in Washington.

The electronic thermometer, known as the "Swiftem", has a thermistor (thermally sensitive resistor) attached at the tip of the delicate steel probe, replacing the old-fashioned glass mouthpiece. The recording meter and the mercury cell battery which supplies the power, are contained in a plastic case small enouguh to fit easily into the palm of the hand. It is operated by a finger button switch, and in appearance resembles a typical photographic light meter. Handpiece and thermometer are connected by a transmission cord. The length of the cord does not affect the sensitivity or accuracy of the instrument. The meter registers degrees of temperature in black figures below normal and red figures above normal. The steel probe is easily detached for sterilisation, and tends to eliminate breakage and loss. The electronic "Swiftem" represents the first change in clinical thermometers since the mercury column type was introduced in 1867.

### New Solvent for Silk

A new solvent for silk is reported by Christopher Earland and David J. Raven in a recent issue of *Nature* (1954, 174, 461). It is found that silk is very readily soluble in formic acid containing small quantities of water and certain inorganic salts at room temperature.. Up to 20 per cent. (*w/v*) of silk may be dissolved in these solutions, which are then semi-solid. Salts which are effective for rendering silk soluble in formic acid include lithium chloride, bromide, iodide and thiocyanate, magnesium, calcium, strontium, zinc and manganese chlorides, and calcium and barium bromides, whereas the alkali metal halides are almost ineffective. The salt concentration is related to the water content of the formic acid. Thus, using 90 per cent. (*w/w*) acid, 10 per cent. (*w/v*) anhydrous calcium chloride is necessary, whereas with 98 per cent. formic acid, only 2 per cent. calcium chloride is required.

Upon dilution with water, followed by vigorous agitation, the silk is precipitated from formic acid calcium chloride solutions as a white curd.

Alternatively, the silk may be obtained as a film by spreading the solution on a glass plate, allowing the solvent to evaporate in a desiccator over solid sodium hydroxide, followed by washing with ethyl alcohol to remove calcium chloride.

## Fourteenth International Congress of Pure and Applied Chemistry

The Fourteenth International Congress of Pure and Applied Chemistry will be held in Zurich, 21-27 July 1955. The Congress will cover pure and applied organic chemistry. A provisional subdivison has been made along the following lines: (1) Theoretical and physical organic chemistry (molecular structure, stereochemistry, reaction mechanisms); (2) Natural products (aliphatic and alicyclic compounds, including terpenes and steroids, carbohydrates, amino acids, aromatic and heterocyclic compounds, alkaloids, glycosides); (3) Synthetic, industrial and analytical organic chemistry (dyestuffs, plastics, tanning agents, synthetic resins, synthetic and analytical methods). The programme also includes five main Congress lectures.

Further particulars may be obtained from Dr. A. L. G. Rees, C.S.I.R.O., Division of Industrial Chemistry, Box 4331, G.P.O., Melbourne, or directly from Dr. Rudolph Morf, Secretary-General, Fourteenth International Congress of Pure and Applied Chemistry, Schonberggasse 2, Zurich, Switzerland.

## Third International Congress of Biochemistry

The Third International Congress of Biochemistry is to be held in Brussels during August 1-6, 1955. The scientific programmes of the Congress will include (i) symposial sessions, (ii) sessions for members' communications, and (iii) general lectures.

There will be thirty-two symposial sessions devoted to the presentation (by invited speakers) of reviews upon tropical subjects. Subjects selected and the sectional arrangements are as follows : organic chemistry of substances of biological interest; chemistry and physical chemistry of proteins and polypeptides; chemistry and physical chemistry of nucleoproteins and nucleic acids; enzymology; intermediary metabolism; biological oxidations and oxidative phosphorylations; biochemical regulations; biochemistry of the cell; biochemistry of muscle and central nervous system; biochemistry of micro-organisms; plant biochemistry and biochemistry of the soil; chemical zoology; nutrition; chemical pathology; chemical pharmacology; clinical chemistry; industrial biochemistry.

Communications from members will be accepted whether or not they fall within the scope of the symposia and will be incorporated into sectional programmes. For further information please write to : General Secretary of the Congress: 17 Place Delcour, LIEGE (Belgique).

## *Indian Journal of Fisheries*

*The Indian Journal of Fisheries* is a new periodical published by the Ministry of Food and Agriculture, Government of India. The Journal is to provide a medium for the publication of original contributions and critical reviews in the field of fisheres research, and would cover subjects relating to fishery biology, fishery technology and other scientific topics of direct and indirect bearing on the development of fisheries science in general and Indian fisheries in particular.

Each volume is expected to contain about 400 pages to be issued in two numbers. The two numbers of the first volume have been issued together.

The Editorial Board consists of the Fisheries Development Adviser to the Government of India, New Delhi (*Chairman*), the Chief Research Officer, Central Inland Fisheries Research Station, Calcutta-7, and the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, S. India (*Managing Editor*). Contributions for publication may be sent to any member of the Editorial Board.

## Fishery Biology and Fisheries in India

Dr. C. P. Gnanamuthu, Director, Zoology Laboratory, University of Madras, Madras-5, has been deputed by the Indo-Pacific Fisheries Council to serve as Bibliography Correspondent for cataloguing and collecting separates of different papers and notices published in India on Fishery Biology and Fisheries. Authors of papers on any topic relating to the above subjects are therefore requested to send separates or full titles of papers to him for transmission to the Indo-Pacific Fisheries Council.

## Award of Research Degree

The Calcutta University has awarded the Ph.D. Degree in Chemistry to Shri Ajit Kumar Mukherjee for his thesis entitled "The Study of Co-ordination Complexes".

# ORGANISATION OF SCIENTIFIC RESEARCH

IT has become increasingly clear in recent years that applied research and development are indispensable for the maintenance of reasonable standards of life in any nation— by developing new technologies in the service of humanity and in the service of the nation through new products, improved processes, higher outputs and improved health and welfare. The need to organise applied research and development work has always been obvious to industrial units, but the concept of a *national* organisation is new and in many countries is only now being attempted.

There is no standard formula for the organisation of research. Differences in political and economic maturity in the stability and structure of industry demand that each country should devise its own form of national organisation. However, certain elements common to all countries are discernible, and these relate to the formulation of a national research

policy, the nature and structure of research establishments, realisation of a wholesome research climate and finally, means and methods of administration and finance. It is therefore clear that the experience of other countries in such matters has a great deal to tell us how we can solve our own. In this connection the Report* of the Technical Assistance Missions set up by the Organisation for European Economic Co-operation (OEEC) to study the organisation of applied research in Western Europe and North America, contains a wealth of useful data and suggestions, which merits careful study. The following is a summary of some points of general interest in this report.

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\* *The Organisation of Applied Research in Europe, the United States and Canada:* Vol. I—A Comparitive Study, Vol. II—Applied Research in Europe, Vol. III—Applied Research in the United States and Canada. Published by the Organisation for European Economic Co-operation, Paris 16e, 1954, Price: 1.00, 2.00, 1.25 dollars respectively.

In all the countries visited by the Missions it has been observed that large and middle-sized industries themselves provide the applied research for their healthy growth, while the Government shoulders the responsibility not only of the research effort for defence, atomic energy and public health, but in great part finances also the institutions for the education of the research personnel, fundamental research, applied research in agriculture as also that of small industrial firms. The importance of private endowments for research would seem to be diminishing, while industry and Government remain as the two great powers behind research.

In view of the complexity of research activities, every country visited has found it necessary to create bodies to supervise and co-ordinate such activities. However, in only a few instances have these bodies given serious thought to the formulation of a national research policy in their fields of interest, taking into account the supply of scientific talent, the natural resources of the country and the needs of industry. It has therefore been suggested that from time to time the national research effort should be evaluated and guidance laid for future research. The result should not be a hard and fast set of executive orders, but rather a memorandum providing information and reasoned recommendations so that it might act as a stimulant to both administrators and research men.

It is a common saying that while Europe has excelled in fundamental research, the Americans have mastered the art of transforming scientific results into practical applications. By way of comment, the report observes that in general the research worker in the United States has undeniably a greater urge to produce practical results, while in Europe there are still some remnants of the old academic schools which pursue scientific research for the sake of pure science, and look down on scientists who do research for industry. However, a large volume of applied research *has* been carried on in Europe for some time now, just as there have been unsurpassed achievements in fundamental science in America. It may well be that any difference in the emphasis placed on fundamental and applied research in various countries reflects a difference in temperament and philosophy, but the balance between the two is a delicate one for any country, and should be maintained at the point as which it yields the greatest return, whether it be to the Government or industry.

The spectrum of national research effort recommended by the Missions as likely to be most helpful is as follows :

(a) Universities should concentrate primarily on teaching and fundamental research ; but Institutes of Technology should include semi-technical and pilot scale work.

(b) Industry should (and in the larger concerns normally does) cover the whole field of applied research and development.

(c) Government research establishments, depending on the industrial responsibilities of Government Departments, should pursue their applied research to the point at which results can be applied or used for further development in industry, or to the point where reliable advice can be given to guide administrative action by Government Departments. It is assumed here that Government research establishments, where they exist, fulfil a national need in applied research which is not being met elsewhere.

(d) Co-operative research establishments, as they exist to serve branches of industry, should cover the whole range of industrial application in their particular field of interest.

(e) The field for sponsored research institutes is to be determined, after duly considering the capacity and efficiency with which industry and Government find it possible to cover their own requirements.

The report has much to say on the conditions which contribute to the creation of a proper research climate. A good research organisation must combine proper management and effective research programmes with an adequate reserve of "scientific capital". This capital is usually composed of individual creative scientists with no administrative abilities, whose talent must be properly harnessed. Considerable care should be taken in recruiting staff to ensure that they are suited to the requirements of the research programme and remuneration should be related to scientific value rather than administrative or practical ability. There should be reasonable parity in the salaries of professional, technical, teaching and research staff. Last, but not the least, it is necessary to create public interest in scientific research. Such an interest, especially in applied research, would appear to be fairly widespread in most

countries, but there were many instances where such interest had not penetrated deeply enough into Government and the industrial circles to initiate active national programmes or convey the real importance of research. This state of affairs should be given serious consideration by appropriate bodies and especially by the scientists themselves. The report observes that people in authority cannot always be blamed for lack of understanding, as they are not specialists and cannot be expected spontaneously to realise all the possibilities of science and technology. In this connection, while it is reasonable for scientists to use a language of their own when discussing problems between themselves, it is at least equally important that they should contrive to make themselves understood by the layman as regards their plans, working methods and results. The popularisation of science should be an integral part of the organisation of research. A great deal about how to conduct such a campaign for the better understanding of research can be learnt from institutions such as the American Chemical Society.

Many of the suggestions put forward by the Missions are directly applicable to our country in its present state of rapid scientific and industrial progress. It is to be hoped that the matter will be taken up for full consideration by those who share the responsibility of shaping the industrial future of our nation.

## NOBEL PRIZE FOR PHYSICS, 1954

THE prize this year is shared by Professor Max Born and Professor Walther Bothe. Professor Max Born is well known for his researches in various branches of theoretical physics. He was among the pioneers who developed the new quantum mechanics in the 1920's, the basic ideas of which have had a profound influence on the progress of physics ever since. More recently, he has made significant contributions towards the unification of the theories of matter and field, and of relativity and quantum theory. During the last few years he has contributed a number of articles on the philosophical foundations of quantum mechanics. Prof. Born has been deeply interested in crystal physics, and is the author of a number of books on this subject. In addition, he has published a large number of books on atomic physics, quantum mechanics and theory of liquids and also semi-popular accounts of modern physics and its philosophy.

Professor Born was in India for short period in 1936, after which he accepted the Tait Chair of Natural Philosophy in the University of Edinburgh. He retired from this position only last year.* He is now seventy-one.

Professor Bothe, who is sixty-three, is a specialist in the field of X-rays and electron physics. His early work was mainly concerned wtih the scattering of X-rays and the photoelectrons ejected from matter by X-rays. To-gether with Geiger, he performed the celebrated experiment on recoil electrons in the Compton effect, and proved definitely that one quantum of X-ray interacts with a single electron in this effect. This paved the way for the further development of the quantum theory of radiation.

Prof. Bothe was associated with W. Kolhorster in a discovery made in 1929, which led to a new and valuable method for the study of cosmic rays. They found that a ray which passed through two Geiger counters in succession was likely to discharge both of them. By suitable arrangements of counters it was possible to define more or less accurately the path followed by individual cosmic rays. A year later, with H. Becker, Bothe was responsible for the first experimental observations in a sequence of discoveries which culminated in the recognition by Sir James Chadwick in 1932 of the neutron as a fundamental particle.

During the years 1939 to 1945, Professor Bothe was engaged in the official atomic research programme in Germany, after which he returned to academic life as Professor of Physics in the Heidelberg University. He has continued his interest in electron physics, although of late he has been specially interested in its applications to cosmic rays and nuclear physics. Amongst other publications, Professor Bothe has to his credit two articles in the *Handbuch der Physik* dealing with the Transmission of Electrons through Matter and the Absorption and Scattering of X-rays.

* A review of the "Festschrift" presented to him on this occasion appears elsewhere in this issue.

## NOBEL PRIZE FOR CHEMISTRY, 1954

THE award of the Nobel Prize for Chemistry to Professor Linus (Carl) Pauling marks the recognition by the scientific world of the outstanding advances made by him in recent years in the field of protein structure.

Our knowledge of the molecular architecture of the protein molecule is now being developed from two directions. One relied on making a direct attack on the intact protein complex in the beginning, and the results seemed to be rather discouraging. Pauling in 1937 decided to attack the problem from another direction by accurately determining the detailed structure of smaller units of the protein molecule such as the amino acids and peptides, thus permitting a good insight as to how the peptide chain would naturally fold itself to form a protein molecule or fibre. After several of these structures had been determined accurately enough, he showed the formation of helical or pleated sheet or layer configurations as structural elements in the several proteins. He also showed that the helices may be twisted about one another to form a compound helix or coiled coil giving rise to configurations like three- or seven-strand cables.

Pauling's investigations cover a very broad field of science including parts of physics, mineralogy, chemistry and biology; but, though varied in nature, they have had a common feature—an emphasis on structure and they may all be considered as being comprised in the general subject of modern structural chemistry. In addition to picturing for us molecules ranging from the simplest to the most complicated proteins and silicates through the determination of many molecular structures, interatomic distances, bond angles, covalent radii and electronegativity of atoms, and binding and resonance energies, he will be remembered for his pioneering work in applying the methods of quantum mechanics to chemistry, and also for popularizing the interpretations of quantum mechanical reasoning and the resonance principle to chemists.

Born in Portland, Ore (U.S.A.), Pauling received his B.S. from Oregon State College in 1922 and his Ph.D. from California Institute of Technology in 1925. Since 1937, he has been Chairman of the Division of Chemistry and Chemical Engineering and Director of the Gates and Crellin Laboratory at CalTech.

A. B. BISWAS.

## RADIOISOTOPES IN INDUSTRY

A BRIEF news report in *Chemical and Engineering News* (1954, **32,** 3036) mentions a few of the monitoring tests that radioisotopes are carrying out. Antimony-124 is being used to check oil pipe line flow; heavy losses are saved every time a change from one grade to another is made. With a Geiger counter at a suitable point outside the pipeline, the arrival of the new grade, if it contains the radioisotope, can be accurately judged. Manganese-54 is being used in paint mixing: minute amounts of this isotope added to the pigment enable the point of uniform mixing to be correctly assessed. Geiger counters on two stirring paddles show uniformity of mixing when each of them records the same amount of radioactivity. Leak detection in enclosed water systems is being aided by iodine-131; the point of leakage can be readily located by the large increase in gamma radiation there. The emission of radiation from radioisotope capsules can be used to measure the thickness of surface coatings while they are being applied to metals. Similarly, flaws in metal castings or welding are shown up if a capsule is placed on one side of the material and a film on the other. Radioisotopes can also be used to eliminate static electricity. Indeed, the known uses are already very numerous although the full potentialities of radioisotopes as control agents in industry have not yet been approached. The AEC has delivered approximately 50,000 consignments of radioisotopes to users in the United States since commercial distribution began.

# ELEMENTS OF THE HELICAL STRUCTURE OF COLLAGEN

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IN a recent communication from this laboratory,[1] a structure has been proposed for collagen consisting of cylindrical "ropes", each rope containing three separate helical chains which are connected together by hydrogen bonds. On the basis of the structure, the meridional arc of spacing 2·86 Å was interpreted as the 113 reflection. The studies of Cowan et al.[2] with stretched collagen indicate that this reflection is truly meridional. Recently the present authors have made similar studies under various conditions, such as different degrees of stretching and moisture content, and these confirm that the 2·86 Å arc is a true meridional reflection. The arc occurs in a photograph taken with the fibre axis at right angles to the X-ray beam only because a small fraction of the fibrils is highly disoriented. When the orientation is improved by stretching, both the intensity as well as the spread of the 2·86 arc diminish for the normal setting, while if the fibre is oriented at the correct angle for the meridional reflection, the 2·86 spot appears with greatly increased intensity. The 4·0 arc on the other hand, breaks up into two well-defined non-meridional reflections when the fibre is tilted to the appropriate angle.

| l | c/l (calc.) | c/l (obs.) | n |
|---|---|---|---|
| 21 | 1·40 | | 3 |
| 20 | 1·47 — | —1·49 | 0 |
| 19 | 1·54 | | 3 |
| 18 | 1·63 | | 4 |
| 17 | 1·73 — | —1·76 | 1 |
| 16 | 1·83 | | 2 |
| 15 | 1·90 | | 5 |
| 14 | 2·10 | | 2 |
| 13 | 2·26 — | —2·3 | 1 |
| 12 | 2·45 — | —2·49 | 4 |
| 11 | 2·67 | | 3 |
| 10 | 2·94 — | —2·92 | 0 |
| 9 | 3·26 | | 3 |
| 8 | 3·67 | | 4 |
| 7 | 4·2 — | —4·3 | 1 |
| 6 | 4·90 — | —4·87 | 2 |
| 5 | 5·88 — | —6·36 | 5 |
| 4 | 7·35 — | —7·38 | 2 |
| 3 | 9·80 — | —9·84 | 1 |
| 2 | 14·70 | | 4 |
| 1 | 29·40 | | 3 |
| 0 | ∞ | — | 0 |
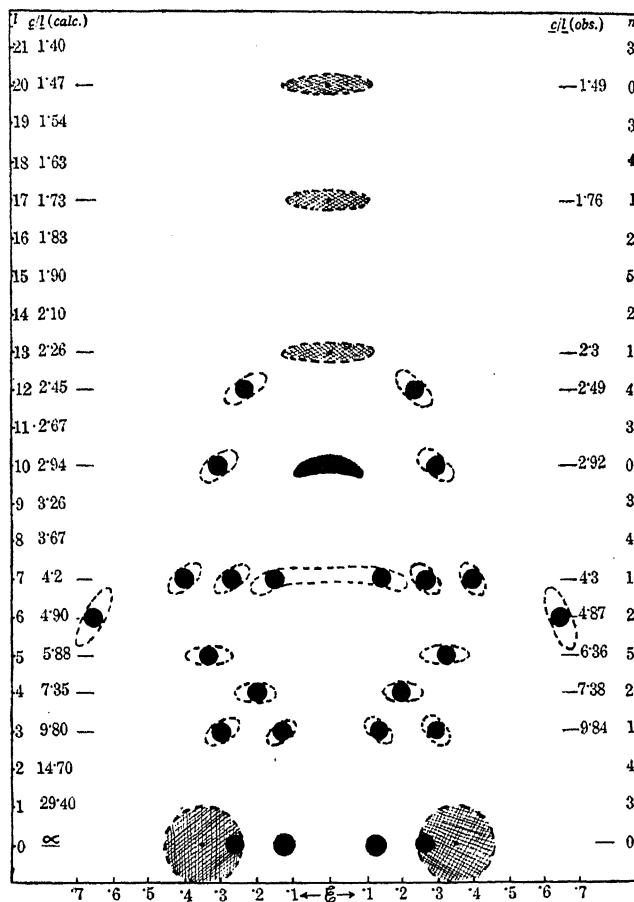
FIG. 1. Schematic diagram of X-ray diffraction pattern of stretched collagen.

In view of the above, the earlier structure clearly requires revision. The photographs obtained show unmistakable evidence of the structure being helical, and they have been analysed with a view to determine the elements of the helix. Cohen and Bear[3] have proposed a helix making 2 turns in about 20 Å and having 7 groups of three residues each in two turns. Bear (private communication) has

made some changes in this description, but the details are not known to the present authors. A careful analysis of the photographs of well oriented collagen show that the experimental data are not fully explained in terms of the above helix having $c = 20$ Å, but that they fit in well with a $c$-axis spacing of $28\cdot6$ Å. The data observed are schematically indicated in Fig. 1, where the layers are arranged according to their $l$-value and the $\xi$ values of the reflections found in each layer are indicated by their $x$-co-ordinate. The data refer to a stretched specimen of air-dried kangaroo tail tendon, for which $c = 29\cdot4$ Å. The observed layer line spacings are shown on the right-hand side, and it will be noticed that they agree well with the calculated spacings, considering that the measurements are accurate only to about 5 per cent.

It is interesting that a reflection having a $\xi$ value of approximately $0\cdot20$ is found in the fourth layer. The corresponding equatorial spacing is $7\cdot7$ Å and the absence of a reflection with this spacing in the zero-layer line has led to some authors[4] questioning the hexagonal unit cell proposed by Pauling and Corey.[5] The existence of this spot in the fourth layer supports the assumption of a hexagonal unit cell made by Ramachandran and Kartha.[1]

It is found that the intensities of the reflections found in the various layers could be explained if the helixes contain 10 residues in three turns, the spacing per residue being $2\cdot94$ Å. The intensities of the various spots which occur in the different layers are theoretically proportional to $J_n (2\pi R \xi)$,[6] where R is the radius of the helix and $J_n (z)$ is the Bessel function of $z$ of order $n$, and $n$ takes the values given by the equation

$$3n + 10 m = l, \quad (m \text{ being integral}).$$

The smallest value of $n$ which is operative for each layer is also given in Fig. 1. It will be seen that (*a*) for values of $l$ from 3 to 10, practically all the expected layers occur,

(*b*) all layers for which $n = 0$ or 1 are observed to occur, (*c*) the spots corresponding to $\xi = 0\cdot14$ occur only in layers having $n = 1$ or 0, and (*d*) when $n > 2$, no spots occur corresponding to $\xi < 0\cdot30$. These facts are in good agreement with what is to be expected from theory.

Further, the smallest $\xi$-value at which spots are observed in each layer can be used to determine the order of magnitude of the radius R of the spiral. This comes out to be of the order of 1 A. On examining the various helical structures proposed so far for collagen,[1,5,7-9] the only structure for which the radius of the helix is of this order is the one described from this laboratory.[1] The helix in that structure contains three residues per turn, while the above analysis of the X-ray data indicates that the helix should contain $3\cdot33$ residues per turn. It may be mentioned that the calculated density agrees much better with the experimental value with $3\cdot33$ residues rather than with 3 residues per turn. Thus, a small modification of the earlier structure would appear to be in good agreement with the X-ray and other data for collagen. Such a modification is not likely to affect the main features of the structure and the details are being worked out in this laboratory.

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## DR. K. R. RAMANATHAN

DR. K. R. RAMANATHAN, Director, Physical Research Laboratory, Ahmedabad, and Chairman, Atmospheric Research Committee, has been elected President of the International Union of Geodesy and Geophysics at the Tenth General Assembly Meeting held in Rome recently. His election to this high office is a gratifying recognition of his services to meteorology for nearly three decades, and is particularly well-timed in view of the global programme for the Third International Geophysical Year now under way. The wide range of his interests is amply reflected in the variety of topics dealt with by him in his scientific publications; but among them special mention may perhaps be made of the study of thermal structure and movements of the upper air, in which field his contributions are outstanding. Our heartiest felicitations to him on the honour conferred on him.

# ON THE NEED FOR A STUDY OF PHAENOCYTOLOGY

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### INTRODUCTION

PHÆNOGENETICS is that branch of genetics which deals with the role of heredity in development. Being an offshoot of formal genetics,[1,2] the methods of inquiry in this field follow the pattern in vogue in the parent science. Application of Mendelian laws to problems in development can have only a limited significance so long as tissue differentiation remains enigmatic.[3] When accumulating evidence indicates that in many instances different tissues of the same organism have varying nuclear complexities[3,4] it behoves one to investigate whether these alterations, from the characteristic constancy in chromosome number in the indifferent cells of the early embryo, have a significance in regard to the origin of the different tissues themselves. It becomes necessary, therefore, to initiate a new field of endeavour, viz., phænocytology.

Elucidation of the role of the nucleus can be attempted from two different directions. The rapid growth of microbial genetics has confirmed the belief that Mendelian laws are valid for all organisms. The morphological characters used in the formulation, analysis and establishment of the Mendelian laws are products of differentiation. Modern trends in cytology emphasize that nuclei undergo changes during differentiation.[4] The universality of the Mendelian laws would be valid only if the characters said to show segregation in microbes are of differentiated cells and the nuclei of which exhibit changes comparable to those undergone by indifferent embryonic cells when they become components of specific tissues. When the nuclear events during the formation of functional germ cells are considered vital to genetic segregation it should be obvious that nuclear phenomena during differentiation may be as significant to the expression of the characters segregated at meiosis.

The picture that emerges from the analysis presented earlier[3] is that during histogenesis, a variety of cytological changes occur in higher organisms. Assuming that what is witnessed is a regular doubling of the whole mitotic complement, it has been suggested[4] that these changes cannot be considered as responsible for differentiation since the same tissue shows more than one degree of endopolyploidy. A rational approach is to investigate whether the complexity assumed by the nucleus during the formation of a tissue is lost during dedifferentiation and a return to an indifferent condition. If it could be further shown, as in *Culex*,[5,6] that such dedifferentiated cells become endopolyploid when they again take part in the formation of another tissue, it would be legitimate to surmise that endopolyploidy may play an important role in differentiation. While the tissues of an organism are often products of irreversible differentiation, microbes are capable of differentiation and dedifferentiation.[7] Microbial cytology assumes, therefore, an unusual significance.

### THE PROBLEM OF DIFFERENTIATION IN MICRO-ORGANISMS

For a correct appreciation of problems it becomes necessary to proceed on well established propositions. (i) The *differentiation-in-space* observed in multicellular organisms becomes one of *differentiation-in-time* in Protista[8] (p. 3). (ii) "The difference in behaviour of the nucleus during different times shows it to be subject to differentiation, as are the larger structures"[8] (p. 12). (iii) Meiosis has been reported in Protista.

It was indicated[3] that meiosis and endopolyploidy could be visualized as results of loss of synchronization in opposite directions, between chromosome reproduction and cytokinesis. Any claim of meiosis in Protista is an admission that one type of differentiation resulting from chromosome reproduction being out of step with cytokinesis does occur. Under the circumstances it would be rather strange if alterations in the nucleus do not occur when there is—as Darlington puts it—*differentiation-in-time*.

*Endopolyploidy in Yeast.*—When could an yeast culture be said to resemble embryonic or meristematic tissue[3] in its behaviour? Obviously two methods of approach are possible. In *Saccharomyces cerevisiæ* a fresh vegetative generation comes into being as a result of the germination of the zygote. The products of the first few divisions should resemble embryonic cells. An investigation of their cytology should reveal the real chromosome number of the strain. Such 'indifferent' cells become fermentative under anaerobic conditions or develop sculpturing when grown on solid media. These changes have been referred to as differentiations.[9–11]

But then, there are yeasts which are asporogenous. Some of them resemble the sporogenous types in their ability to ferment some of the sugars as well as develop sculpturing on

solid media. Sporogenous types themselves could be kept in the vegetative phase for a period of years. Any technique for the demonstration of mitosis in yeast should be capable of adaptation to sporogenous as well as asporogenous varieties. It may be recalled that bacterial cytologists—without offering a rationale—emphasize the use of *young* cultures alone for investigations.[12] It should be obvious, therefore, why Subramaniam[13] urged the use of young aerobically growing cultures for the study of mitosis in yeast.

Availability of mitosis as a 'standard' for evaluation rendered it possible to study variations in cytological behaviour under a variety of environmental conditions. The occurrence of endopolyploidy in yeast did not appear to us as something unique. Though the first report dealt with only fermenting cells,[14] it has been shown subsequently that yeast growing as agar streaks[15] or as giant colonies[16] are also endopolyploid. Thus the broad conclusion could be drawn that nuclear changes accompany differentiation in yeast.

*Nuclear Changes in Protozoa.*—Is such a conclusion valid for other micro-organisms as well? *Paramœcium*, for instance, possesses two nuclei subserving different but complementary functions. The micronucleus is solely concerned with reproduction as well as the replacement of the senile macronucleus. The macronucleus, on the other hand, is said to be intimately associated with the control of the physiological functions of the organism.[17] While Sonneborn[17] suggested that it is compound, Kimball[18] claims that it is polyploid. Since the macronucleus has only a limited span of life and in view of the distinction made between polyploidy and endopolyploidy,[3] it has to be considered as endopolyploid.

The situation is naturally different when we come to the uni-nuclear Protista. The same nucleus should have to alter its constitution and behaviour to changes in physiology. Many protozoan populations, free-living as well as parasitic, contain giant forms whose chromosome make-up is unknown. Wenrich[19] suggests that they may be polyploid individuals in view of the reported occurrence of endomitosis in *Barbulanympha* and his own observation of interrupted nuclear divisions in *Entamœba muris*. Apparently Wenrich is referring to the occurrence of endopolyploidy.[3] There is thus sufficient indirect evidence available to show that endopolyploidy may be as widespread a phenomenon in Protista, as it is in higher organisms.

*Nuclear Changes in Bacteria.*—Bacteria are no exception if some of the observations of Robinow[12] are viewed in the proper perspective. Each cell of *Bacterium coli* or *Proteus vulgaris* possesses only a single chromatinic structure or one or two pairs of these. With the aging of the culture, the appearance of enigmatic, atypical forms, possessing increasing numbers of chromatinic structures, has been reported. Robinow[12] gives a diagram where the atypical forms are arranged in an ascending grade of complexity (Fig. 3, p. 178). Judged in relation to the problem of dissociation[7]— not dissociation as understood in bacteria[20]—is it surprising that some of the descriptions of Robinow are reminiscent of the phenomenon of endopolyploidy?

### The Problem of Dedifferentiation

When bacteria from old cultures show enigmatic chromatinic structures, does repeated subculture at short intervals produce a dedifferentiation and a return to an 'indifferent' condition? Is that the rationale for the use of *young* cultures for cytological investigations? The same problem is met with in yeasts also. It is possible to demonstrate normal mitosis in asporogenous yeasts like *Candida*[21] and *Rhodotorula*[22] by culturing them under optimal conditions of aeration and nutrition. Obviously the problem of dedifferentiation in yeast can be investigated only after an extensive survey of the cytological changes that accompany differentiation. This is what has been attempted in this laboratory during the past one decade. The stage is thus set for a planned analysis of the cytological changes that occur during dedifferentiation.

Though generally not realized, fertilization itself is a classical example of dedifferentiation. The functional germ cells like the sperm and ova are transformed cells and as such have only a limited span of life.[3] Fertilization brings about a loss of differentiation and a return to the indifferent condition. After a short or long period of mitotic proliferation, these cells begin once again to differentiate in an integrated fashion into the various tissues and organs of the adult organism.

*Dissociation and Dedifferentiation.*—The integration seen during development is very precise. "But it seems to be a very important, if perhaps insufficiently appreciated fact, that these fundamental mechanisms are not separable only in thought; on the contrary, they can be dissociated experimentally or thrown out of gear with one another"[7] (p. 505).

We saw earlier[3] that normal dissociation of the mechanism of mitosis results in meiosis and endopolyploidy. It would be desirable, there-

fore, to make a distinction between 'dissociation' and 'dedifferentiation'. Just because it is possible to throw out of gear experimentally the integrated mechanisms, it does not mean that a tissue may be capable of regular dedifferentiation. Cultures of different tissues may look alike under particular conditions. For example, cells of the liver are not capable of being transformed into those of the kidney and *vice versa*. Under proper conditions, the cells of the respective tissues do take up their specific functions. These apparent dedifferentiations have been classified under a separate category known as 'modulations'.

*Cytology of Dedifferentiation.*—Interest in the dynamic aspects of cytology is yet to develop. The only solitary instance where a detailed study has been made of the cytology of dedifferentiation is in the ileum of *Culex*.[5,6] Endopolyploid cells undergo somatic reduction and thus return to an indifferent condition as a prelude to their subsequent transformation into fresh tissue.

*Reversible and Irreversible Differentiations.*— Regular dedifferentiation can take place only when there has been a uniform duplication of all the chromosomes as in *Culex*. On the contrary, if there has been (*i*) loss of chromosomes, (*ii*) differential reproduction of chromosomes, or (*iii*) differential reproduction of regions of chromosomes during histogenesis,[3] such changes by their very nature lead to irreversibility. In lower organisms, with enormous powers of regeneration, differentiations appear to be reversible. With a rise in the evolutionary ladder there is a concomitant loss of the power of regeneration. It is tempting to inquire, therefore, whether such a loss is the consequence of irreversible changes in the nuclei.

*Dedifferentiation in Yeast.*—Wort cultures left standing for years are said to contain viable cells.[23] Since in a fermenting culture most of the cells are endopolyploid, two possibilities for the persistence of viable cells have to be considered : (*a*) unmodified cells capable of normal mitosis may continue to persist in such cultures ; (*b*) endopolyploid cells may dedifferentiate and return to an indifferent condition. In a liquid culture, the cells become fermentative when anaerobiosis sets in. As a prelude to fermentation it is that the cells become endopolyploid. Naturally, therefore, it is difficult to visualize the persistence of indifferent cells in such cultures. Are the viable cells the result of dedifferentiation of endopolyploid cells ?

The discovery of the peculiar type of "somatic reduction",[24] whereby a bud with the regular mitotic complement of two chromosomes

originates from an endopolyploid cell, became interesting in this context. It appears to be a form of dedifferentiation. Such phenomena are seen in yeast cultures of varying ages from both solid and liquid media. It is a common experience that a loop of material transferred to fresh media results in the appearance of a fresh crop. The cells transferred show an ascending grade of complexity. The question arose whether the fresh crop is the result of proliferation of the indifferent cells alone or whether even the endopolyploid cells are capable of regular dedifferentiation. Recent investigations indicate that endopolyploid cells do return to the indifferent mitotic condition by a series of cell divisions unaccompanied by any simultaneous chromosomal reproduction.

It was shown earlier[3] that endopolyploidy can have a significance only in relation to differentiation and not to the hereditary make-up of the organism. The nuclear changes observed during differentiation and dedifferentiation in a micro-organism reinforces such a conclusion. *Is Endopolyploidy the Cause of Differentiation ?*

The critical surveys presented enable the formulation of some basic principles on the basis of which problems in Phænocytology could be approached. These are : (1) Differentiation is common to both unicellular and multicellular organisms. (2) The nucleus is capable of undergoing modifications. (3) Functional germ-cells like components of tissues and organs are products of differentiation. (4) Organization and integration of changes are seen not only during development but also in cells undergoing differentiation. (5) Dissociation of nuclear from cytoplasmic events could be in different directions.

Ideas regarding the significance of endopolyploidy are yet to crystallize.[25] As a consequence there appears to be a tendency to treat the phenomenon as a mere corollary to histogenesis.[4,26] Each tissue of *Gerris* is said to show a specific degree of complexity. "Thus, the nuclei of the tracheal epithelium were diploid or tetraploid, those of fat body tetraploid, octoploid and 16-ploid; those of œnocytes up to 128-ploid; while in the salivary glands Geitler found giant branching nuclei which were estimated from their volume and from the number of X chromosomes, to be 512-ploid, 1,024-ploid and even 2,048-ploid"[26] (p. 210). Attention is invited to the fact that the highest complexity is observed in salivary glands. Secretory cells show visible evidences of their activity. As a prelude to the appearance of secretory granules there is hypertrophy of the cytoplasm, the mitochondria, the Golgi apparatus and the nucleus.[27]

It is such cells which show a high degree of endopolyploidy. In the context of the limited span of life of secretory cells, the changes in their nuclei can have a significance only to the functioning of the cells and not to the genetic make-up of the organism.

From his survey, Huskins[25] arrives at the conclusion, that endopolyploidy may be a device enabling quantitatively different gene action in different tissues. Proceeding on similar lines Schultz[28] is faced with a dilemma. While there

be in a direction entirely different from that of the rest.

The same three categories of events could be recognized during histogenesis also. When the consequences of the different types of dissociation during meiosis have a significance to the hereditary make-up of the succeeding generation, it would indeed be surprising if analogous changes during histogenesis can have no meaning to the origin of different tissues and organs.

## Units of dissociation

| | Chromosome complement | Individual chromosome | Region of a chromosome |
|---|---|---|---|
| Meiosis .. | Regular reduction | Polysomy Aneuploidy | Misdivision Isochromosome |
| Endopolyploidy .. | Regular duplication *e.g.* *Culex*[5,6] | X and Autosomes 512-ploid. Y 4-ploid, *e.g.* Nurse cells[28] | Heterochromatin and granules in bands of salivary chromosomes[29] |

is no valid reason for postulating equal rates of reproduction during endopolyploidy, anything contrary to the above would necessitate the assumption of differences of quantity of genes, and hence of the genic balance, in different tissues and organs. When there is differential reproduction not only of chromosomes constituting the mitotic complement, but of even parts of individual chromosomes,[3] differences in genic balance are naturally to be expected.

### A New Synthesis

The problem of endopolyploidy has not up till now been analysed as an aspect of the general phenomenon of dissociation between nuclear and cytoplasmic events during differentiation. An enormous literature on the different aspects of meiosis being available, it is possible to proceed from the known to the unknown. There are three different orders of changes during meiosis. When the unit of dissociation is the whole mitotic complement, regular reduction in chromosome number could be expected. If, on the other hand, it is the chromosome that is the unit, polysomy and aneuploidy would be the result. It may so happen that a specific region of a chromosome may be the unit. The 'misdivision' of the centromere resulting in the formation of an isochromosome is a typical illustration of this type of change.[29] Attention is invited to the fact that reproduction of a region of a chromosome could

Indifferent Mitotic Cells
↓
Meiosis←——Dissociation——→Endopolyploidy

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# LETTERS TO THE EDITOR

## TOTAL CROSS-SECTIONS FOR NUCLEAR SCATTERING

THE optical model of the nucleus, proposed by Fernbach, Serber and Taylor[1] has been used to account for the nuclear scattering of nucleons at various energies. Such a model is defined by a certain nuclear density distribution and characterised by a complex refractive index written as

$$n = 1 + (\bar{k}_1 + i\,\bar{K}/2)\rho/k \qquad (1)$$

where $\rho$ is the nuclear density distribution and $\bar{k}_1$ and $\bar{K}$ are independent parameters while $k$ is the nucleon momentum. Usually a uniform density distribution has been employed. However, recently Gatha, Shah and Patel[2] have used the radial distribution method for analysing the nuclear scattering of 340 Mev. nucleons and obtained a characteristic nuclear density distribution for light elements described by

$$\rho\,(\bar{r}) = N \sum_{q=1}^{3} \alpha_q \exp\,(-\beta_q \bar{r}^2) \qquad (2)$$

where

$N = 0 \cdot 066 \times 10^{13}$ cm.$^{-1}$,

$\alpha_1 = 3 \cdot 77 \times 10^{26}$ cm.$^{-2}$,  $\beta_1 = 28 \cdot 94 \times 10^{26}$ cm.$^{-2}$,

$\alpha_2 = 2 \cdot 94 \times 10^{26}$ cm.$^{-2}$,  $\beta_2 = 3 \cdot 83 \times 10^{26}$ cm.$^{-2}$,

$\alpha_3 = 1 \cdot 50 \times 10^{26}$ cm.$^{-2}$,  $\beta_3 = 0 \cdot 75 \times 10^{26}$ cm.$^{-2}$,

and

$$\bar{r} = r \times A^{-1/3}.$$

Using the above density distribution the present authors have derived an expression for total scattering cross-section in the first Born approximation. This is given by

$$\sigma_t = \bar{K}A + \lambda(\bar{k}_1{}^2 - \bar{K}^2/4)A^{4/3} \qquad (3)$$

where

$$\lambda = 0 \cdot 016 \times 10^{27} \text{ cm.}^{-2}$$

Using the experimental values of $\sigma_t$ as given by Nedzel,[3] we have calculated the parameters of the complex refractive index through a least

square computation using equation (3). This gives $\bar{K} = 34$ mbn and $\bar{k}_1 = 6$ mbn. The value of $\bar{K}$ is close to the value of $33 \cdot 6$ mbn for the total cross-section of hydrogen as expected, while the value of $\bar{k}_1$ is close to 7 mbn. given by Jastrow's model for nucleon-nucleon interaction. In the present investigation we have used the above parameters and compared the experimental values of $\sigma_t$ with the theoretical values as shown in Table I.

Since the total cross-sections for 315 Mev. protons for light elements have been recently measured,[4] we have also investigated the validity of the above expression at this energy.

We obtain $\bar{k}_1 = 9$ mbn from Jastrow's hard core nucleon model which is supported by the data at 340 Mev.[2] Moreover, the absorption parameter $\bar{K}$ is given by

$$\bar{K} = (\epsilon/2)\{\sigma_{np} + \sigma_{nn}\} \qquad (4)$$

We can regard the exclusion factor $\epsilon$ equal to unity at such a high energy. Using the experimental values of $\sigma_{np} = 32 \cdot 5$ mbn and $\sigma_{nn} = \sigma_{pp} = 24 \cdot 3$ mbn, we have taken $\bar{K} = 28$ mbn. The calculated values for the total cross-section using these parameters are also given in Table I, together with the experimental values of $\sigma_t$.

TABLE I
*Total cross-section in millibarns*

| Element | | 400 Mev. neutrons | | 315 Mev. protons | |
|---|---|---|---|---|---|
| | | Th. | Exp. | Th. | Exp. |
| Be | .. | 230 | 232 | 217 | $229 \pm 6$ |
| C | .. | 297 | 298 | 286 | $292 \pm 6$ |
| O | .. | 381 | 379 | 374 | $379 \pm 10$ |
| Al | .. | 590 | 588 | 607 | $580 \pm 16$ |
| S | .. | 677 | 681 | 708 | $686 \pm 18$ |
| Cl | .. | .. | .. | 750 | $740 \pm 20$ |

The above comparison shows that the characteristic density distribution for light elements and the parameters of the complex refractive index given above provide reasonable values for the total cross-sections for this scattering process.

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Ahmedabad-9,                G. Z. Shah.
*June* 24, 1954.

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## RELIABILITY OF THE SEMI-EMPIRICAL MASS FORMULA IN THE CALCULATION OF NEUTRON BINDING ENERGY

A RELIABLE determination of the neutron-binding energy is essential for the study of nuclear structure. As experimental data are lacking for various nuclei, it is worthwhile calculating the neutron-binding energies from semi-empirical atomic mass formula and compare the results with the experimental data wherever available.

Let $M(Z, A)$ denote the mass of the atom of atomic number Z and mass number A, and $M_0(Z, A)$, the mass of the bare nucleus. Then $M(Z, A) = M_0(Z, A) + mZ$, $m$ being the electronic mass. We have then,

$$M_0(Z, A) = M_0(Z, A-1) + M_n - B_n(Z, A) \qquad (1)$$

where $M_n$ is the mass of the neutron $= 1 \cdot 00898$ and $B_n(Z, A)$ is the neutron-binding energy in mass units. Using atomic masses, we have

$$M(Z, A) = M(Z, A-1) + M_n - B_n(Z, A) \qquad (2)$$

or $B_n$ in Mev. is given by

$$B_n(Z, A) = 931 \cdot 15\,[M(Z, A-1) + M_n - M(Z, A)] \qquad (3)$$

where $M(Z, A)$ is given by the Fermi-Weisacker semi-empirical atomic mass formula.[1] Using the above results, neutron-binding energies have been calculated in the range $Z = 81$ to $Z = 85$ and $N = 123$ to $N = 131$ where N is the number of neutrons. The results are given in Table I.

TABLE I
*Neutron-binding energy of nuclei in Mev.*

| N \ Z | 81 | 82 | 83 | 84 | 85 |
|---|---|---|---|---|---|
| 123 | 5·941 (6·57) | 6·146 (6·49) | .. | .. | .. |
| 124 | 7·058 (7·48) | 7·254 (8·15) | .. | .. | .. |
| 125 | 5·708 (6·23) | 5·904 (6·68) | .. | 6·313 (6·71) | .. |
| 126 | 6·807 (6·88) | 7·012 (7·37) | 7·207 (7·44) | 7·403 (7·77) | .. |
| 127 | 5·466 (3·87) | 5·661 (4·34) | 5·866 (4·17) | 6·062 (4·56) | .. |
| 128 | 6·574 (5·08) | 6·770 (5·20) | 6·965 (5·09) | 7·151 (6·01) | .. |
| 129 | 5·242 (3·2) | 5·429 (3·79) | 5·633 (4·31) | 5·829 (4·81) | .. |
| 130 | .. | 6·527 (5·31) | 6·723 (5·31) | 6·918 (5·87) | 7·105 (5·89) |
| 131 | .. | 5·214 (3·36) | 5·410 (4·08) | 5·596 (4·57) | 5·801 (4·7) |

The experimental values are given within parentheses and are taken from the work of Kinsey[2,3] and Harvey.[4]

A few points arise from the examination of the calculated values. The calculated values of $B_n$ for $N \leqslant 126$ are nearly in agreement with experimental data. But for $N > 126$ the difference between the experimental and the estimated values increases and ranges from 1-1·5 Mev. or nearly 25-40 per cent. The reason is that when a neutron shell is complete ($N = 126$), the nucleus becomes particularly stable and hence $B_n$ should decrease. This observation corresponds to the view already expressed by many workers.[5-8] Thus the semi-empirical mass formula which is based upon a nuclear model without shell structure is not reliable in giving the binding energy after the completion of the nuclear shell.

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## A FORMULA FOR THE K- AND L-ABSORPTION DISCONTINUITIES

SEVERAL empirical relations have been suggested for the magnitude of the K absorption jump ratio ($r_K$):

(a) by Jönsson[1]
$$r_K = \lambda_{L_1}/\lambda_K = E_K/E_{L_1} \tag{1}$$
where $E_K$ and $E_{L_1}$ are the energies of K and $L_1$ states respectively.

(b) by Rindfleisch[2]
$$r_K = aZ^b \tag{2}$$
with $\log_{10}a = 1·805283$ ; $b = -0·6207$.

(c) by Laubert[3]
$$r_K = a\lambda_K^b \tag{3}$$
with $\log_{10}a = 0·857652$ ; $b = 0·0843$.

(d) by Tellez-Plasencia[4]
$$r_K = (a' + bZ)^{-1},$$
which he writes as
$$Q_K = 1 - \frac{1}{r_K} = a - bZ \tag{4}$$
where $a = 1 - a'$. By putting $a = 0·948833$ and $b = 0·0024882$ a good agreement is obtained with the experimental values. Plasencia further showed that analogous relations of the

various described forms can also be given for the L-absorption jump ratios.

In view of the fact that the data for various elements available from different workers are distributed over a wide range, it is difficult to decide in favour of any one of the suggested relations. However, in the absence of any satisfactory theoretical treatment of topic, a selection can be made on the ground of its agreement with the experimentally well established general formula.
$$\tau_a = CZ^p\lambda^n \tag{5}$$
for the true atomic absorption coefficient, neglecting the scattering.

In (5) the values of C and $p$ change at critical absorption wavelengths. The value of $n$ remains independent of the branch of the curve because the curves on the logarithmic plot may be taken to be parallel. Therefore, for the K-discontinuity it is possible to write
$$\tau_a = CZ^p\lambda^n, \text{ for } \lambda < \lambda_K$$
and
$$\tau_a' = C'Z^{p'}\lambda^n, \text{ for } \lambda_K < \lambda < \lambda_L$$
where $\lambda_K$ and $\lambda_L$ denote the K- and L-absorption limits respectively. Regarding $\tau_a$ and $\tau_a'$ to be the absorption coefficients close to the K-absorption discontinuity on the short and long wavelength sides respectively, it is possible to write the K-absorption ratio as
$$r_K = \tau_a/\tau_a' = (C/C')Z^{p-p'}$$
Putting $a = C/C'$ and $b = p - p'$, we have $r_K = aZ^b$ which is of the same form as the relation (2) employed empirically by Rindfleisch to represent $r_K$. In view of the accepted form of the relation between $\tau_a$, Z and $\lambda$ the form (2) for $r_K$ appears to be the most rational one.

The author wishes to thank Dr. G. B. Deodhar for his kind interest in this work.

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## BAND SPECTRUM OF TUNGSTEN OXIDE

IN continuation of the work of one of the writers on tungsten oxide in the Astrophysics Laboratories of the Vatican Observatory,[1] further work is undertaken. In addition to the bandheads of WO reported to have been obtained by Foster and Gaydon[2] and partly analysed by A. Gatterer and S. G. Krishnamurthy,[1]

new data were obtained from photographs of the infra-red region taken in the Spectroscopy Laboratories of the Imperial College, London (by S. G. K.) and of the visible region at low and high currents (two and twenty-three amperes) taken in this laboratory (by V. V.).

Four new systems of bands have been found starting with $\nu\nu$ 12911·0, 14160·8, 16073·3 and 21226·9 as the (0, 0) bandheads of the corresponding Deslandres schemes. Two of these, photographed in this laboratory from two ampere and twenty-three ampere arcs, are given below.

| $v''$ / $v'$ | 0 | 1075·5 | 1 | 1088·2 | 2 |
|---|---|---|---|---|---|
| 0 | 16073·3(6) | | | | |
| | 971·7 | | | | |
| 1 | 17045·0(4) | | 15969·5(4) | | |
| | | | 979·0 | | |
| 2 | | | 16948·5(3) | | 15860·3(3) |

| $v''$ / $v'$ | 0 | 1066·4 | 1 | 1057·8 | 2 |
|---|---|---|---|---|---|
| | 21226·9(5) | | 20165·8(2) | | |
| | | | 965·9 | | |
| 1 | | | 21131·7(3) | | |
| | | | 974·2 | | |
| 2 | 23177·6(2) | | 22105·9(3) | | 21048·1(2) |
| | | | 938·1 | | |
| 3 | | | 23044·0(2) | | |

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Presidency College,      S. G. KRISHNAMURTHY.
Madras, *July* 9, 1954.

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## NEW SEDIMENTS IN THE REWA SERIES (UPPER VINDHYAN SYSTEM) FROM SATNA DISTRICT, VINDHYA PRADESH*

THE following succession of beds has so far been recognised[1-3] in the Rewa Series (Upper Vindhyan System) in the Bundelkhand area: Upper Rewa sandstone, Jhiri shales, Lower Rewa sandstone, Panna shales and Rewa limestone.

While mapping in the erstwhile Baraunda State (now merged in Vindhya Pradesh and forming part of the Satna District), the present author discovered that in a part of this area in addition to the above horizons a succession of beds consisting of sandstones, shales and limestone occurs below the Rewa limestone and overlying the Kaimur sandstone. These beds total about 60' in thickness and occur in perfect conformity with the overlying sequence. They have been traced over a distance of about 10 miles and an area of about 80 sq. miles.

A slight erosional unconformity between the basal limestone bed of this new succession and the Upper Kaimur sandstone is noticeable.

It is proposed to designate these newly discovered beds as the "Paisuni Stage" after the Paisuni river in whose valley they have been found to occur in great force. Thus, the Vindhyan succession in this area as established by the new survey is as follows:

Rewa limestone and the younger beds

Paisuni sandstone ⎫
Paisuni shales     ⎬
Paisuni limestone ⎭
Kaimur sandstone

The Paisuni limestone, about 5' in thickness, is greyish-green and buff in colour, and resembles the Rewa limestone in appearance. It forms the bottom-most horizon of the entire series and rests over the Kaimur sandstone. The overlying shales average about 35' in thickness in the area covered so far. They are generally of chocolate and green colour, and are highly fragmented. In general, the Paisuni limestone and shales are very closely similar to the younger Rewa limestone and the Panna and Jhiri shales respectively; and if examined in isolated outcrops it is indeed difficult to distinguish between the two sets.

The thin-bedded Paisuni sandstone, about 20' in thickness, found underlying the Rewa limestone is, however, lithologically different from the other sandstones found in the Rewa series. The typical Rewa sandstones are indurated, compact and white or pink-coloured, while the Paisuni sandstone is a softer, somewhat loose-grained, greenish coloured and slightly foliated rock. The green colour is due to the presence of chlorite. Fine specks of muscovite are also observed. This sandstone is much softer than the other Rewa sandstones and is a distinguishing feature of the Paisunis.

It appears that these beds occupy a much larger area than the Baraunda territory and their outcrops extend eastwards into the Banda District of Uttar Pradesh. Systematic mapping on regional basis will reveal the full extent of their outcrop.

A detailed account and geological map of these formations in the type area will be published in due course.

I am indebted to Dr. A. G. Jhingran, Geological Survey of India, for his active encouragement.

Geological Survey of India,          S. M. MATHUR.
Lucknow, *May* 21, 1954.

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\* Published by permission of the Director, *Geological Survey of India*.

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## PIEDMONTITE FROM ROBERTSON-PET, MYSORE

PIEDMONTITE, the rare manganese member of the epidote group, was first reported in Mysore by the present author.[1] It has been studied in greater detail from its optical and chemical points of view and the results of the study are set forth in the present paper.

Piedmontite is fairly well developed in the champion gneiss at its contact with the hornblende schist in two localities near Robertsonpet, namely, 1 furlong south of Kemputhimmanahalli ($78° 17' 34'' : 12° 56' 17''$) and 3 furlongs east of Masika ($78° 17' 0'' : 12° 56' 28''$). The optical study of a number of grains of the mineral reveals that $X \wedge C = -5°$ and $2V$ varies between $75°$ and $80°$ with an average value of $76°$. The optical characters of the mineral, as compared with those described by Short[2] and Simonson[3] from California, are as follows :

| Robertsonpet (Mysore) | Madera County California | Los Angles County California |
|---|---|---|
| X = pale lemon yellow | X = Orange yellow to lemon yellow | X = orange yellow to lemon yellow |
| Y = pale amethyst | Y = amethyst to amethystine red | Y = amethystine red |
| Z = pale red | Z = carmine | Z = carmine |
| $\gamma - \alpha = 0.029$ | $\gamma - \alpha = 0.060$ | $\gamma - \alpha = $ High |
| $X \wedge C = -5°$ | $X \wedge C = -4$ to $5°$ | $X \wedge C = -3$ |
| $2V = 75$ to $80°$ | $2V = 64$ to $75°$ | $2V = 70$ to $80°$ |

It is seen from the above comparison that the Mysore mineral agrees generally with the Californian minerals in its optical characters. It is significant, however, that the birefringence of the Californian minerals is very high, nearly twice as compared with that of the Mysore mineral.

A powder of this mineral, obtained by Thoulet solution, was analysed by Sri. T. D. Bhaskar, Central College, Bangalore, and it was found to contain $12.5$ per cent. $Mn_2O_3$, which is very similar to the $Mn_2O_3$ content ($12.13$ per cent.) of piedmontite from Madera County,[4] California. On plotting the optical characters, $2V$ and $X \wedge C$ and $Mn_2O_3$ content of the Mysore mineral in the variation diagram proposed by A. M. Short[5] for piedmontites, it is seen that the values fit into the $X \wedge C$ and $2V$ curves perfectly. Short, in his study of piedmontites from California, showed with the help of the variation diagram that excess of manganese increases $2V$ and $X \wedge C$ and decreases the indices of refraction. In this connection he observed, "From data recorded by Larsen and from Anderson's conclusions, it is very probable that the $N_g$ and $N_p$ curves converge with increase of $Mn_2O_3$, but not enough data are available to justify a definite statement".[6] The Mysore mineral, like the piedmontite from Madera County, California,[7] occurs replacing biotite in a metamorphosed volcanic rock and thus agrees very closely with the latter not only in its mode of occurrence but also generally in its optical and chemical characters.

The author desires to express his indebtedness to Sri. L. Rama Rau and Dr. C. S. Pichamuthu for valuable suggestions and to Sri. T. D. Bhaskar for determining the manganese content of the mineral.

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*July* 24, 1954.

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## RESOLUTION OF MIXTURES OF AMINO ACIDS BY CIRCULAR PAPER CHROMATOGRAPHY*

ASIDE of the method of separation of amino acids by two-dimensional chromatogram, there are so far only two methods for this purpose, using the uni-dimensional technique. Redfield and Barron[1] have developed a method for the separation of a mixture of 18 amino acids, which

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requires the use of seven different solvents. McFarren[2] has achieved the separation of amino acids by using six solvents buffered at different pH in seven different chromatograms. In an earlier communication,[3] it has been shown as to how a mixture of amino acids can be analysed by circular paper chromatography. Subsequently, it was realised that the method was fairly time-consuming and not quite easy of adoption for routine work. The problem of the resolution of a mixture of amino acids by circular paper chromatography has been, therefore, further investigated, and it has been found that a mixture of amino acids can be resolved, as given below, in three different chromatograms by using (1) n-Butanol saturated with water at 20° C., (2) a mixture of n-Butancl, water, acetic acid in the proportion of 40 : 14 : 5 and (3) a mixture of n-Butanol, water, acetic acid in the proportion of 40 : 5 : 15. The method, in brief, is as follows. 5 $\mu$l of the solution (pH 6-7) of amino acids, prepared in the concentration of 0·05 per cent. in 10 per cent. isopropanol, is spotted cn the circumference of a circle of 1″ radius, which is drawn at the centre of a filter circle of 9″ radius. This big size circle is cut out from a Whatman Paper No. 1, which has been previously chromatographically washed, first with N/100 hydrochloric acid and then twice with distilled water. After air-drying the spot, the chromatogram is run at 18-20° C., till the solv-



FIG. 1. Solvent used; Butanol saturated with water at 20° C. Number of runs : Three. Time of each run : 18 hours. Order of Separation :
L–IL–Ph–Va–Try-$\alpha$-AB Pr–Al–Th–Hpr–Gly–Hi–Ag–AA
| | | | | |
Me Ty $r$AB Se Ly
| |
Glu Or
|
Cy

ent boundary reaches the periphery of the paper. This takes about 16-18 hours. At the end of this period, the chromatogram is removed and dried in the air. In the case of solvents I and III, after drying, the chromatogram is run again, and this procedure is followed once more. The accompanying photographs of sectors of chromatograms illustrate the order in which the amino acids separate. Thus, it can be seen that, in the absence of $\alpha$- and $\gamma$-amino butyric acids, leucine, isoleucine, phenylalanine, tryptophan, tyrosine, proline, alanine, threonine, hydroxy-proline, histidine and arginine are separated with solvent I (Fig. 1), phenylalanine, valine, methionine,



FIG. 2. Solvent used : Butanol–Acetic acid–water (40 : 5 : 14). Number of runs : One. Time of run : 16 hours. Order of Separation :
L–Ph–Va–Me–Try–Ty–Pr–Al–Th–Hpr–Gly–Ag–Or–Cy
| | | |
IL Glu Se Hi Ly
|
AA

tryptophan, tyrosine, proline, alanine, hydroxyproline and cystine are separated with solvent II (Fig. 2), and methionine, threonine, glutamic acid, hydroxyproline, glycine, serine, aspartic acid, arginine, ornithine and cystine are separated in solvent III (Fig. 3). Except lysine, all the remaining amino acids can be separated in three separate chromatograms with these three solvents. Lysine, however, can be separated, if ornithine is eliminated from the mixture, when it will come as a separate band above cystine in a chromatogram run with the solvent II.

The method has been employed for the quantitative estimation of amino acids in edestin hydrolysate. The details of the work will be published shortly.

The authors wish to thank Dr. M. Sirsi for
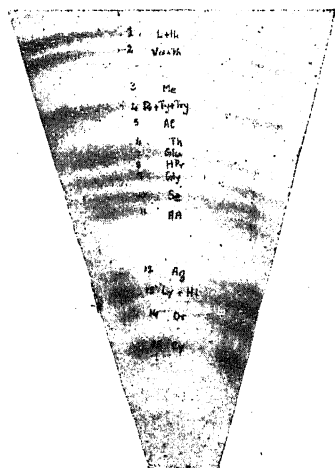
FIG. 3. Solvent used: Butanol–Acetic acid–water (40 : 15 : 5). Number of runs: Three. Time of each run : 17 hours. Order of Separation :

L–Ph–Me–Pr–Al–Th–Glu–Hpr–Gly–Se–A A–Ag–Ly–Or– Cy
| | | | Hi
IL Va Ty
|
Try

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Section of Pharmacology,       N. A. N. RAO.
Indian Inst. of Sci.,          T. K. WADHWANI.
Bangalore-3, *July* 13, 1954.

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## VOLTAMMETRIC ESTIMATION OF LEAD WITH POTASSIUM FERROCYANIDE

IN a previous publication[1] the precipitation of $Pb_2Fe(CN)_6$ in the voltammetric titration of lead solutions with potassium ferrocyanide was reported. The work has since been extended with a view to use this titration for the quantitative estimation of small amounts of lead.

The manual polarographic arrangement[2] using dropping mercury electrode (D.M.E.) was employed. Dissolved oxygen was eliminated from the solutions by bubbling purified nitrogen. The supporting electrolyte was $0.1 M$ $KNO_3$, and every 50 ml. of the lead solution to be titrated contained 0.5 ml. of 0.05 per cent. gelatine solution as a maximum suppressor. The titrations were carried out at D.M.E. potential of $-0.55$ volt *vs.* S.C.E. where the diffusion current in the cathodic reduction wave of $Pb^{++}$ has a limiting value. Potassium

ferrocyanide is not reduced at the D.M.E.[3] Titrations of $0.001$ to $0.008 M$ solutions of $Pb^{++}$ have been carried out. The titration curves were L-shaped. Table I gives a typical set of observations.

TABLE I

*Voltammetric titration of lead nitrate with potassium ferrocyanide*

Volume of lead nitrate solution $= 50$ ml.;
E.M.F. applied $= -0.55$ volt *vs.* S.C.E.;
Temperature $= 30° \pm 0.1°$ C.

| Strength of $Pb(NO_3)_2$ soln. | Strength of $K_4Fe(CN)_6$ soln. | Calculated titre value in ml. | Observed titre value* in ml. |
|---|---|---|---|
| 0.0010 M | 0.0250 M | 1.000 | 1.000 |
| 0.0016 | 0.0250 | 1.600 | 1.607 |
| 0.0016 | 0.0499 | 0.802 | 0.810 |
| 0.0020 | 0.0499 | 1.002 | 1.005 |
| 0.0040 | 0.0999 | 1.001 | 0.997 |
| 0.0056 | 0.0999 | 1.401 | 1.405 |

\* Mean of three observations. The individual titres were within 0.01 ml. of the mean values

The method enables estimation of $Pb^{++}$ within an error of 1 per cent. and can be employed even in presence of $Ba^{++}$ and $Ca^{++}$ which complicate the estimation of lead as oxalate, chromate or sulphate.

Thanks are due to Prof. R. P. Mitra for his interest in the work.

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University of Delhi,       HARISH C. GAUR.
Delhi, *August* 14, 1954.   N. A. RAMAIAH.

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## CHROMOSOME NUMBERS IN SOME SPECIES OF THE GENUS *ALYSICARPUS* NECK.

THE genus *Alysicarpus* belonging to the family *Papilionaceœ* consists of a number of species widely distributed throughout Africa, Asia, Australia and the American tropics. In Index Kewensis and its supplements, 31 species of this genus are listed of which 13 are stated to occur in India. Cooke's *Flora of Bombay Presidency* records 9 of the Indian species in the Bombay State, where they are found usually growing in grass lands and are used as forage. In the course of botanical and agronomic studies in progress at this laboratory on the available species of fodder value, the chromosome numbers were counted in six species of the genus occurring in Bombay

State. The chromosome numbers are given
below as the first count in the genus.

Seeds from plants grown and identified were
used for chromosome counts. I am indebted
to Rev. S. J. Santapau of St. Xaviers College,
Bombay, for confirming the specific nomencla-
ture. The seeds were germinated after treat-
ment with strong sulphuric acid for 15 minutes.
Well-grown root-tips were fixed, blocked and
cut. Karpechenko's fluid was used for fixation
after a trial with different fixatives. The stain-
ing was with crystal violet. Chromosome
counts were made from intact cells. The soma-
tic number $2n$ is 16 in all the six species, *viz.*,
(1) *Alysicarpus-buplurifolius*, D.C. (2) *A. longi-
folius*, Wight and Arn, (3) *A. monilifer*, D.C.,
(4) *A. pubescens*, Law, (5) *A. rugosus*, D.C.
and (6) *A. vaginalis*, D.C. In the species,
*A. vaginalis* a variety *nummularifolius* also has
sixteen chromosomes.

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Poona, *April* 20, 1954.

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## ORGANIC ACIDS IN BANANAS

CHARACTERIZATION of non-volatile organic acids
in bananas has been a subject of controversy.
Corenwinder[1] ascribed the acidity in banana
as due to malic acid and this was confirmed
by Wehmer[2] while working with the green
fruit. Bigelow and Dunbar[3] generalized that
banana contained only malic acid. The pre-
sence of citric acid along with malic acid was
reported by Hartmann and Hillig,[4] but this
was contradicted by Harris and Poland[5] who
concluded that the total titratable acidity of
the fruit is accounted by 1-malic acid. Minute
quantities of oxalic acid were traced in plan-
tain[6-7] and also in ripe bananas.[8] Fonseca[9]
detected citric, malic, boric, tartaric, acetic and
butyric acid in the two varieties of Brazilian
bananas. The presence of tartaric acid in the
ripe fruit[8] and glycosuccinic acid in unripe
fruit[10] has also been reported. Since most of
the earlier work pertained to the Gros Michael
variety of banana, it was considered desirable
to extend the work to indigenous varieties with
a view to determining whether any fresh acid
could be detected.

100 g. of the pulp made into paste was ex-
tracted with 200 c.c. of 80 per cent. alcohol on
a cheese cloth. The extract was centrifuged
and made alcohol free on a water-bath and
made upto a known volume. The organic acids
present in the extract were studied by ascend-
ing paper chromatographic technique using

butanol-formic acid-water (10 : 2 : 5) as solv-
ent. and bromo-cresol-green as spraying re-
agent. For each variety green and ripened
stages were selected and, in all, nine different
varieties listed below were examined.

1. POOVAN—*Musa sapientum* Linn. var.
   Poovan.
2. CHAKKARAKELI (Syn. *Raja Vazhai*)
   *Musa sapientum* var. *Chakkarakeli.*
3. PACHABALE—*Musa cavendishii* Lamb.
   var. *Pacha vazhai.*
4. CHANDRA BALE—*Musa sapientum* Linn.
   var. *Chenkadali.* (Syn. *Chandrabale*).
5. RASABALE—*Musa sapientum* Linn. var.
   *Rasthali.*
6. KADA BALE—*Musa balbisiana* Colla.
   Clone *Kade bale.*
7. NENDRA BALE—*Musa sapientum* Linn.
   var. *Nendran.*
8. PEYAN—*Musa sapientum* Linn. var.
   *Peyan.*
9. MADURANGA—*Musa sapientum* Linn.
   var. *Monthan.* (Syn. *Madhuranga bale.*)

The chromatogram readings revealed that all
the abovementioned varieties of banana, con-
tained citric acid and 1-malic acids as the only
non-volatile organic acids. Both of these acids
were found in ripened as well as unripened
stages of the fruit. The identification of these
two acids was confirmed by chemical tests. The
chemical tests carried out for acetic, boric,
tartaric, oxalic and butyric acids were found
negative in all the indigenous varieties of
banana.

The authors' thanks are due to Dr. V. Subrah-
manyan for his keen interest in the work, and
to Shri T. Gopalan Nayar for assistance in
assigning botanical names for the banana
varieties.

Central Food Tech.         B. S. LULLA.
  Res. Institute,          D. S. JOHAR.
Mysore, *July* 26, 1954.

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## NEW OBSERVATIONS ON THE AFFERENT BRANCHIAL SYSTEM OF *HETEROPNEUSTES FOSSILIS* BLOCH, (ACTINOPTERYGII; OSTARIOPHYSI; SILUROIDEA)

DURING investigations on the respiratory system of Indian fresh-water fishes it was noticed that no satisfactory account of the circulation in this region exists in literature on the subject. In regard to the afferent branchial system in *Heteropneustes fossilis*, the sketch and account by Burne[1] does not show either the origin or the opening of these arteries. Neither do Das[2] and Hyrtl[3] give any adequate description of this system. A remarkable new type of arrangement of these arteries, which has not been reported before in any Indian fish, is reported here.

It was observed that three pairs of afferent arteries, the second, the third and fourth, all originate from the same opening on the roof of the ventral aorta (Af. b. 2nd, 3rd and 4th, Fig. 1). The ventral aorta, immediately after
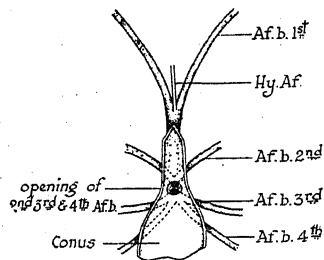


FIG. 1. Afferent branchial arteries in *Heteropneustes fossilli ç*

piercing the pericardium, gives off two branches: one directed forwards and the other backwards. The forwardly directed branch divides into two immediately after it is given out, to form the second pair of afferent branchial arteries. While the second branch, which is backwardly directed, also divides into two, and each one of them in turn divides into two— the third and fourth afferent branchial arteries of the right and left sides. The third and fourth afferent arteries *of each side* thus arise from a common root. The two common roots of the third and fourth afferent arteries arise in turn from the single aperture from which the common root of the second pair of afferent branchial arteries also originate. Thus, *six arteries* (the right and left, second, third and fourth afferent branchial arteries) in all originate from the ventral aorta by a single opening and thus have *one common root.*

On the other hand, the first pair of afferent branchial arteries (Af. b. 1st) are formed separately by the forking of the ventral aorta in level with the ventral end of the first branchial arch. Before the ventral aorta divides into the first pair of afferent branchial arteries, it gives out a single median artery supplying the hyoidean arch. This artery has been named as the hyoidean afferens (Hy. Af.), after the region it supplies.

It is possible that this peculiar origin and arrangement of the afferent branchial arteries in *Heteropneustes fossilis* (as in *Ophicephalus striatus*, Das and Saxena[4]) is correlated with the air-breathing habit of the fish. Further work is in progress and details will be published later. My grateful thanks are due to Dr. S. M. Das of Lucknow University under whose guidance the work is being carried out.

Dept. of Zoology,                D. B. SAXENA.
The University, Lucknow,
*August 2, 1954.*

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## ON THE DERMAL GLANDS OF SOME INDIAN SCORPIONS

IN most arthropods the cuticle is usually perforated vertically by numerous prominent ducts arising from special epidermal cells called dermal glands. Wigglesworth[2] suggested that the role of the dermal glands was to form the outermost layer of the cuticle, namely, the outer epicuticle which may be formed shortly before or shortly after moulting.

In *Palamnœus swammerdam*, Krishnan[1] described prominent dermal gland ducts which arising from the hypodermis opened externally to the amber layer of the cuticle. It, therefore, appears from his account as well as from his diagrams that these stop short beneath the epicuticle and do not open to the exterior. These have been reported to contain Sudan IV staining lipoids which presumably are discharged into the epicuticle. In the illustrations given by Krishnan[1] the dermal glands appear to be unicellular and are studded with some granules.

During an investigation on the cuticle of the arthropods the writer observed that in *Palamnœus bengalensis* similar prominent dermal gland ducts of about 8 $\mu$ in diameter pierced the hard cuticle (Fig. 1, 4). These arise from the



Fig. 1.          Fig. 2.

Fig. 3.      Fig. 4.          Fig. 5.          Fig. 6.
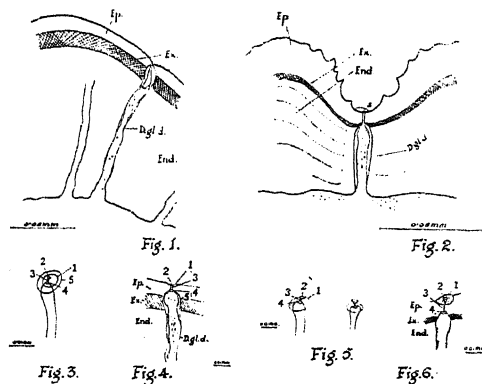
FIG. 1. T.S. cuticle of *Palamnœus bengalensis.*
FIG. 2. T.S. cuticle of *Buthus tamulus gangeticus.*
FIG. 3. Opening of a dermal gland of *Palamnœues bengalensis* as seen in whole mount. FIG. 4. Opening of a dermal gland of *Palamnœus bengalensis* as seen in transverse section. FIG. 5. Opening of dermal gland of *Buthus tamulus gangeticus* as seen in whole mount. FIG. 6. Opening of dermal gland of *Buthus tamulus gangeticus* as seen in transverse section. *Ep,* Epicuticle. *Ex,* Exocuticle. *End* Endocuticle. *D. gl. d,* Dermal gland duct. *S,* Dried secretion. 1. Depression in epicuticle. 2. External opening. 3. Canal in epicuticle. 4. Projected rim of dermal gland duct. 5. Opening in exocuticle.

flask-shaped gland cells in the hypodermis and traverse the entire endocuticle and exocuticle. These ducts at first sight also appear to end blindly into the epicuticle as presumably described for *Palamnœus swammerdam,* but careful examination of a large number of sections revealed that the openings usually observed corresponded actually to the rim formed by the exocuticular material surrounding the ducts. The real opening in *Palamnœus bengalensis* lies in a shallow depression on the outer surface of the cuticle and is in communication with the dermal gland duct below through a fine ductule in the epicuticle. It is seldom that the sections pass through this ductule without being slightly oblique and that is why most of the sections do not show the actual opening. The structures observed in transverse sections were verified and compared by the writer from an examination of a whole mount of the cuticle under changing focus of the microscope (Figs. 3, 5). The distribution of the dermal glands occurs roughly about 100

per sq. mm. although this distribution may not be uniform all over.

In another scorpion, *Buthus tamulus gangeticus,* examined by the author similar dermal glands were found to be present in the cuticle. Their position and course is more or less the same as in *Palamnœus bengalensis.* The external opening here lies in a special pit and the ductule is very long (Figs. 2, 5, 6). The cuticle here is also thrown into denticular projections. The distribution of these glands, though not uniform, occurs slightly less per sq. mm. as compared to that in *Palamnœus bengalensis.*

In freshly cut unstained sections these dermal gland ducts appear to be filled up with violet-coloured and vacuolated cytoplasm studded with some granules (Figs. 7 and 8).



Fig. 7.          Fig. 8.
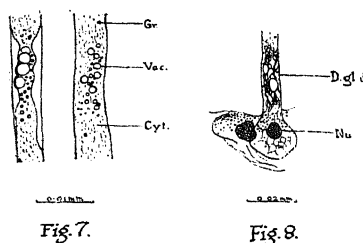
FIG. 7. Portion of dermal gland ducts to show vacuolated cytoplasm. FIG. 8. A dermal gland cell of *Palamnœus bengalensis. Gr.*–Granule. *Vac.*–Vacuole. *Cyt.*–Cytoplasm. *Nu,* Nucleus of dermal gland. *D. gl. d,* Dermal gland duct.

These are stained deep blue with Mallory, Delafield and Heidenhain hæmatoxylin and there is evidence that these are discharged to the exterior (Fig. 6). A blue staining material can sometimes be seen extending from the duct into the ductule in the epicuticle or as glandular exudation which often accumulates on the orifice of the duct. The writer did not get evidence for the presence of any material staining with Sudan IV in these dermal gland ducts.

Further work is in progress. My thanks are due to Dr. M. B. Lal for guidance. Thanks are also due to Scientific Research Committee, Uttar Pradesh, for providing funds to carry out the work.

Dept. of Zoology,          S. C. SHRIVASTAVA.
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*June* 12, 1954.

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## BLOSSOM BLIGHT OF *ZANONIA INDICA* LINN.

A BLIGHT of blossoms of *Zanonia indica* Linn. due to *Choanephora cucurbitarum* (Berk. & Rav.) Thaxt. was observed at Dacca in September 1953. The above disease has not been reported so far on any species of *Zanonia*. The earliest indication of the disease is the appearance of minute brown spots on the petals. These spots rapidly enlarge and turn black, involving the entire corolla and the calyx. During moist weather the affected flowers appear soft and rotting, but under dry conditions they appear only withered and discoloured. As the disease progresses the discolouration and the rotting extend down into the pedicels and the rachis. The affected flowers ultimately become covered with a brilliant crop of silvery white conidiophores.

Sporangia, sporangioles and zygospores not observed on host, developed in monosporic cultures. The conidiophores and conidia produced in cultures were similar in shape and size to those found on the host.

Inoculation of the inflorescence with conidial suspension in water gave positive results, the symptoms developing within 24-36 hours. The organism was reisolated from the infected tissues. The inflorescence in the control series remained free from disease.

Thanks are due to Prof. G. P. Majumdar for the facilities accorded for work.

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University of Dacca,      K. A. MAHMUD.
Dacca, *July* 13, 1954.

## BEHAVIOUR OF TAPETAL CELLS DURING MICROSPOROGENESIS OF *LENS ESCULENTA* MOENCH.

Two main types of tapetal cells have been recorded, the secretory type in which the cells remain *in situ* without breaking their walls, and the amoeboid type in which cell-walls are dissolved and the contents of the cells wander in the pollen sac. In *Lens esculenta* the tapetal cells show an intermediate behaviour. The innermost wall layer of the anther acts as tapetum and its cells remain uninucleate throughout their life. By the time uninucleate pollen grains are formed in the anther, the walls of the tapetal cells are dissolved and the contents of the tapetal cells form a peripheral layer around the microspores instead of wandering in the pollen sac (Fig. 1). This tapetal periplasmodium which forms a peripheral layer

round the microspores disappears by the time binucleate pollen grains are formed. Dnyansagar[1] reported an intermediate behaviour of
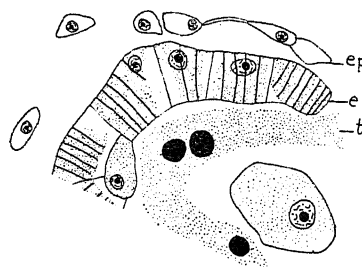


FIG. 1. T. S. anther. Note epidermis (*ep*) is degenerating, endothecium (*e*) has acquired fibrous thickening and tapetum (*t*) has formed periplasmodium at the periphery of the anther locule, × 74'.

tapetal cells in *Adenanthera pavonina* Linn. but in this case the tapetal cells loose contact with each other and migrate between the groups of mother-cells. Such a behaviour of tapetal cells as observed during the course of present investigation has not been recorded so far.

I am highly thankful to Dr. Bahadur Singh for kind guidance.

Dept. of Biology,        T. C. SHUKLA.
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Bulandshahr, *July* 15, 1954.

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## NATURE AND OCCURRENCE OF SEPTA IN FOLIAR SCLEREIDS OF *SCINDAPSUS* SP.

IN the course of studies on the foliar sclereids in monocotyledons the author noticed the presence of thin septa in certain foliar sclereids of *Scindapsus pictus* Hassk. and *S. officinalis* Schott., belonging to Araceæ.

Sclereids have been recorded in certain members of Araceæ.[1-3] They have been variously termed as bast cells,[4] poils,[1] internal hairs,[5] trichoblasts,[6] "Sclereiden"[2] and tricho sclereids.[3] The foliar sclereids of *Scindapsus* are disposed in a more or less parallel manner inside the lamina, do not show any relationship with veins and are peculiar in having processes resulting in H-shaped forms. They do not form regular strands but leave considerable spaces between them. They are of three types: thick and fusiform, H-shaped and others of variable size and shape. The fusiform sclereids are variable in length and sometimes branched at the ends (Fig. 4). The cell walls are thick and striated and possess a narrow lumen which is sometimes occluded. The

pits are prominent and canal-like in the thick sclerosed wall. The H-shaped forms are remarkable for their conspicuousness. They attain considerable lengths, possess a thick striated wall and a broad or narrow lumen of irregular width. The arms vary in lengths, their ends are fusoid and may be branched, and sometimes their lumen is occluded. The third type comprises very much elongated or arrested forms of variable size and shape. There is a strong tendency to attain the H-shape as revealed by the existence of a series of intergrading forms. They possess a slightly or moderately thickened striated cell wall and a broad or narrow lumen of irregular width. A noteworthy feature is the presence of septa in the lumen (Figs. 1, 5 & 6) which is filled with



Ordinary (Figs. 1, 4 and 5) and Polarised light between crossed Nicols (Figs. 2, 3).

FIG. 1. H-shaped sclereid with septa in the lumen, × 225.

FIGS. 2 and 3. H-shaped sclereid reveals the double refraction of the cell wall, × 225 and × 125.

FIG. 4. A fusiform sclereid with branched tip, × 125.

FIG. 5. A portion of fusiform sclereid showing broad septate lumen, × 225.

FIG. 6. H-shaped sclereid showing a broad or narrow lumen of irregular width, × 125.

air or ergastic substances, and occasionally crystals. De Bary[5] reported the occurrence of

a few thin septa in the lumen of the 'internal hairs' of Aroideæ. They give a negative reaction to cellulose tests. Under crossed nicols they are completely cut out, resulting in a dark field at all positions of the stage whereas the striated secondary cell wall exhibits a birefringence (Figs. 2, 3) and undergoes extinction four times during the complete rotation of the slide on the stage (detailed account of septa formation will appear elsewhere). The septate sclereids are similar to some fibre cells, which later become septate as reported by Vestal and Vestal[7] in *Hypericum androsæmum* and by Spackmann and Swamy[8] in many other dicotyledons. Most of the sclereids in seed plants are non-septate, whereas the fibres which are of common occurrence in many dicotyledons are septate. Thus we have in *Scindapsus* sp. sclereids resembling fibres and fibres resembling sclereids. This further emphasises the difficulty of distinguishing one from the other.

I wish to thank Prof. P. Maheshwari for going through the manuscript.

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*June 14, 1954.*

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## MYCETOMES AND SYMBIOTES IN *LEPTOCORISA VARICORNIS* FABR. (COREIDAE, HEMIPTERA)

ASSOCIATION of micro-organisms with certain insects of the order Hemiptera was discovered as early as 1892 by Forbes.[1] Later Glasgow,[2] Kuskop,[3] Rosenkranz[6] and Schneider[7] worked on the nature and possible method of transmission of these micro-organisms from one generation to another. The location of these organisms or symbiotes as they are called, in their hosts may be extra- or intra-cellular.

Two rows of sac-like cæca are attached to the wall of fourth ventriculus of the midgut of *Leptocorisa varicornis* (Fig. 1). Similar
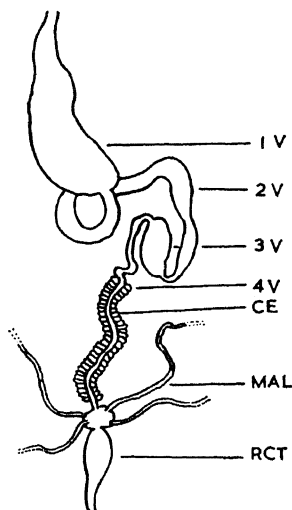


FIG. 1. Intestine of *Leptocorisa varicornis* F. showing mycetomes. CE, mycetomes or cæca ; MAL, malpighian tubes ; RCT, rectum ; 1 V—4 V, ventriculus of midgut.

structures in other insects have been termed as 'gastric cæca' or 'bacterial crypts' but here they will be referred to as mycetomes which is now a widely accepted term for such special organs harbouring symbiotes. The size, shape and nature of symbiotes vary in different insect species. They may range from minute cocci to large spirochætes and from yeast to protozoa. In *Leptocorisa varicornis* they are minute rod-shaped bacteria, 1-1·5 $\mu$ long, which can readily be seen in mycetomic smears stained with Giemsa (Fig. 2). A study
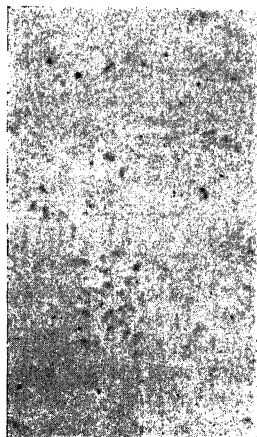


FIG. 2. Bacterium-like symbiotes of *Leptocorisa varicornis* F.

of smears of other parts of intestine shows that bacteria are present in enormous numbers only in the mycetomes and not elsewhere. There appears to be only one type of bacteria in the mycetomes.

Very little is known about the physiology of symbiotes found in insects. Only in a few cases like those of *Lasioderma serricorne* and *Stegobium paniceum*,[4] and *Rhodnius prolixus*[8] have they been found to supply some of the factors of vitamin B complex. In termites[5] they aid in digestion. Nothing, however, is known regarding the exact function of bacteria of *Leptocorisa varicornis*, but in the light of the recent researches in insect-microbiology there is reason to assume that they may perhaps be of some importance in nutrition or digestion. This of course requires further studies, which are in progress.

I wish to thank Dr. M. L. Bhatia, Head of the Zoology Department, Delhi University, for providing me with facilities for research.

Dept. of Zoology,  N. C. PANT.
University of Delhi,
Delhi, *July* 6, 1954.

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## KARYOTYPES IN *DIPCADI* MEDIC.

THE genus *Dipcadi* consists of about 45 species,[3] most of them being found in tropical South Africa, a few in Southern Europe, tropical Asia and Madagascar. Hooker,[4] recording six species in India, writes "The Indian species want a thorough re-examination, with far better materials than I have access to". Blatter and McCann[1] have added two new species, viz., *D. saxorum* Blatter and *D. ursulæ* Blatter from Bombay and Panchgani respectively. Chromosome numbers are known only in two species : *D. serotinum* and *D. glaucum*, with $2n = 8$ and $2n = 18$ respectively.[2] There has been, however, no work done in India on any of the Indian species. Therefore, it seemed desirable to investigate this genus thoroughly from the view-point of morphology, cytology and embryology, as it was felt that it may throw

some light on the interrelationships of the Scilloideæ to which tribe it belongs.

Such a study was undertaken by us and in the present paper a brief account of the karyotypes in three species, *viz.*, *D. montanum* Baker, *D. saxorum* Blatter and *D. ursulæ* Blatter, is given.

The root tips were raised from the bulbs and they were fixed in Lewitsky's fluid. The usual paraffin method was followed and sections were cut at 14 $\mu$.

*D. montanum* has the diploid number of chromosomes as $2n = 20$ (Fig. 1). The chromo-
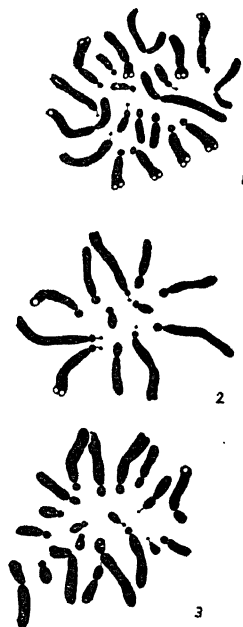


FIG. 1. *Dipcadi montanum.* Somatic metaphase showing 20 chromosomes.
FIG. 2. *Dipcadi saxorum.* Somatic metaphase showing 12 chromosomes.
FIG. 3. *Dipcadi ursulæ.* Somatic metaphase showing 20 chromosomes.
All Figures × 1,800.

somes are fairly long except for the three pairs which are comparatively short. Two pairs of long and one pair of medium-sized chromosomes have sub-median constrictions. The rest have sub-terminal constrictions. Two pairs are noticed with satellites. There is, however, one pair with secondary constrictions not noticed in the other two species.

In contrast with the other species, *D. saxorum* has a low number of $2n = 12$ (Fig. 2). Except for one pair of chromosomes which are very short, the rest are all long. In this species all the chromosomes have sub-terminal constrictions. Sub-median constrictions found in

the other species are not noticed. There are, however, two pairs of chromosomes with satellites.

*D. ursulæ*, like *D. montanum*, has $2n = 20$ chromosomes (Fig. 3). However, its karyotype differs from that of *D. montanum*. The diploid complement in *D. ursulæ* consists of four pairs of short and six pairs of long chromosomes. There is only one pair with sub-median constrictions. Another pair has somewhat sub-median constrictions. All the other pairs have sub-terminal constrictions. As in the other two species, in this also there are two pairs of satellited chromosomes.

Of the three species studied, *D. saxorum* differs from the other two in its chromosome number. Though *D. montanum* and *D. ursulæ* have the same chromosome number, their karyotypes differ. However, it is of interest to note that all the three species have two pairs of chromosomes with satellites. This, apparently, has some bearing on the evolutionary tendencies within the genus, but too much stress cannot be laid on this point at present as other species have not been available for study.

As regards distribution, *D. montanum* has a comparatively wider range, occurring from Rohilkund in the north to Belgaum in the south, whereas *D. saxorum* and *D. ursulæ* are endemic to small areas in Bombay and Panchgani respectively. Detailed papers on the cytology and embryology of these species will appear elsewhere.

We are thankful to Mr. P. S. Chikkannaiah for supplying the material.

Dept. of Botany,        T. S. Mahabale.
University of Poona,     M. S. Chennaveeraiah.
Poona-7, *July* 23, 1954.

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2. Darlington, C. D. and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945.
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## EFFECT OF SULPHUR FERTILIZATION ON THE PUNGENCY OF ONION

Four doses of elemental sulphur (commercial grade) replicated six times in randomised blocks were employed as fertilizer—one week after transplanting onion seedlings in the first week of November. The usual cultural operations were carried out and the bulbs were harvested in the first week of April. Pungency was measured by estimating the volatile sulphur

content of the bulbs, by the method described by Platenius.[1] Fresh weight and dry weight measurements on the bulbs harvested from the differently treated plots were also made.

TABLE I

*Effect of sulphur fertilization on increase of pungency in onion bulbs*

| Sulphur applied as fertilizer | | Volatile sulphur in the onion bulb in P.P.M. | Average fresh weight per bulb | Dry matter % | Pungency (smell) in 3 month stored samples |
|---|---|---|---|---|---|
| Zero | .. | 134·4 | 80·3 g. | 8·97 | + |
| 50 lb./acre | .. | 200·0 | 97·4 g. | 9·43 | + + |
| 100 lb./acre | .. | 280·0 | 100·4 g. | 10·05 | + + + |
| 200 lb./acre | .. | 336·0 | 96·3 g. | 10·11 | + + + |
| 400 lb./acre | .. | 352·0 | 86·7 g. | 9·99 | + + |

+ denotes presence of pungency ; + + denotes medium pungency; + + + very pungent.

Table I indicates increase in volatile sulphur content of bulb with increase in elemental sulphur fertiliser. However, the rise is much less in the higher doses than in the relatively lower ones. Pungency as diagnosed by intensity of smell does not agree entirely with the upward trend of volatile sulphur content in the bulb.

Plant Physiology Section,          K. KUMAR.
College of Agriculture,             R. K. SAHAY.
Banaras Hindu University,
*July* 26, 1954.

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## TWO NEW SPECIES OF *SYNCHYTRIUM* FROM BIHAR

BUTLER collected a number of species of *Synchytrium* in Bihar some of which were recorded by Butler and Bisby.[1] Lacy[2] and Mishra[3,4] have described a few species recently. The author collected some species of *Synchytrium* in the monsoon of 1953 two of which were found on examination to be undescribed. An account of these species proposed as new is given below.

1. *Synchytrium micranthum* sp. nov.

Galls on leaves, numerous, crowded together presenting warty appearance, distinct, simple, orange yellow, turning brownish. Sporangial sori, orange yellow, polygonal, thin-walled, smooth, surrounded by several layers of elongated rectangular host cells forming the gall, measuring 68·5–145·8 $\mu$, average 128·5 $\mu$ in diameter. Sporangia about 100–150 in number, hyaline to yellow and 22·2–35·9 $\mu$, average 28·4 $\mu$

in diameter. Resting spores numerous, associated with sporangial sori ovate to spherical, thick-walled, greyish-brown, dispersed in several layers of the gall tissue, measuring 55·5–142·2 $\mu$, average 107·5 $\mu$ in diameter.

Hab. on leaves and stems of *Micranthus oppositifolius* Wendl., Begusarai, Bihar, 23-10-1953, Leg. G. P. Singh.

*Micranthus oppositifolius* Wendl., a member of Acanthaceæ, is a weed commonly found in orchards and along the roads. Plants of different ages were found infected with the fungus. Prominent galls were produced on both surfaces of the leaves but mostly on the lower surface where they were aggregated towards the mid-ribs, veinlets and the pedicels. On the stems, galls were lodged mostly in the ridges.

2. *Synchytrium cessampelum* sp. nov.

Galls on leaves and stems, pale yellow turning brownish, simple, minute, inconspicuous, mostly aggregated near veins on the leaves. Resting spores spherical, thick-walled, greyish yellow with greyish oil reserve, covered over with a single layer of thin-walled elongated epidermal cells, measuring 16·3–68·8 $\mu$, average 45·8 $\mu$ in diameter. Prosori and Sporangia not observed.

Hab. on leaves and stems of *Cessampelos pareira* Linn. Hazipur, Bihar, 4-9-1953, Leg. G. P. Singh.

*Cessampelos pareira* Linn. is a medicinal plant of the family Menispermaceæ. Infection spots on the leaves and stems were minute and not easily distinguishable in the field. In dry specimens it becomes still very difficult to locate the galls. Cook[5] described *Synchytrium cocculi* on *Cocculus carolinus*, a member of the same family but his species differs in all the essential features from the fungus described here.

Further studies on the life-history of these fungi are in progress.

The writer wishes to acknowledge his indebtedness to Dr. J. N. Mishra, for his valuable suggestions and encouragement.

Division of Mycology and          G. P. SINGH.
Plant Pathology,
Sabour (Bhagalpur), Bihar,
*August* 17, 1954.

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5. Cook, M. T., *Mycologia*, 1951 B, 43, 590.

## MEGASPOROGENESIS AND MEGA-GAMETOPHYTE DEVELOPMENT IN *COMBRETUM OVALIFOLIUM* ROXB.

Two types of development of megagametophyte have been described in the genus *Combretum.* For instance, Mauritzon[1] reported the formation of a 16-nucleate megagametophyte of the Peperomia type in two species of *Combretum* (*C. pincianum* and *C. paniculatum*) and Venkateswarlu[2] reported the development of a 8-nucleate megagametophyte of the Polygonum type in *C. coccineum* (*Poivera coccinea* DC). The present note deals with megasporogenesis and development of megagametophyte in *Combretum ovalifolium.*

The ovary is inferior, unilocular and usually contains two ovules which are bitegmic, crassinucellate and anatropous. Megasporogenesis proceeds normally and the megaspore mother cell forms a linear tetrad of megaspores (Fig. 1). The chalazal megaspore functions, the other three degenerate (Fig. 2). The development of the megagametophyte corresponds to Polygonum type. The egg apparatus is made up of two synergids and the egg. The synergids show a filiform apparatus. The two polar nuclei are usually situated below the egg. The antipodals degenerate early (Figs. 3, 4, 5). At certain stages of megagametophyte development, the nuclei of the gametophyte were found to disintegrate (Fig. 6).

My sincere thanks are due to Prof. L. N. Rao for kind encouragement.

Dept. of Botany,                    M. NAGARAJ.
Central College,
Bangalore, *September* 10, 1954.

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FIG. 1. A linear tetrad, × 320.
FIG. 2. A linear tetrad showing the chalazal megaspore developing and the other three degenerating, × 320.
FIG. 3. Two-nucleate megagametophyte, × 160.
FIG. 4. Four-nucleate megagametophyte, × 160.
FIG. 5. Eight-nucleate megagametophyte, × 160.
FIG. 6. Four-nucleate megagametophyte with two chalazal nuclei degenerated, × 70.

## *PHYLLOSTICTA CYCADINA* (PASSER) ON *CYCAS REVOLUTA*

ALTHOUGH Chibber reported *Phyllosticta cycadina* on *Cycas* sp. from Poona for the first time in India, symptoms were not described and pathogenicity not established by him. Infected portion of a leaflet first become yellowish, later changing to light brown. In a large number of cases, the disease starts from the tip proceeding towards the base but in some, it appears as irregularly distributed brown spots. Finally, the infected portion from the tip becomes ash-coloured and may develop black pycnidia, which are more numerous on the lower than on the upper surface. The ash-coloured portions with or without pycnidia get crumpled and fall off, the whole process taking about 4-5 months. The disease is more marked from October to February.

Isolations from the infected regions invariably gave *Phyllosticta cycadina.* The pathogenicity was tested on *Cycas revoluta, C. rumphii, Cladium* sp., *Dracœna* sp., palm, *Canna indica, Chenopodium album* and *Solanum nigrum,* but it was found to infect *Cycas revoluta* only. Symptoms similar to those observed in nature were produced by artificial inoculations, only when sufficient moisture was available. The disease appeared earlier if the inoculations were made in the evening but the process was slower whenever the inoculations were made in the morning. The first symptoms of the disease appeared 8 days after inoculation, provided moist cotton pads were regularly placed for 4 days. They appeared after 12 days when the plants were kept in the

moist chamber, but not at all if sufficient moisture was not maintained near the inoculum. The infection was earlier during winter and on the fifth day, the mycelium could be traced inside the host tissues. No infection developed on the uninjured upper surface, but the disease appeared without any injury on the lower surface. This difference may be due to the presence of thick cuticle on the upper surface as against numerous stomata on the lower surface. Sections revealed that except in the injured regions, the fungus generally entered through the stomata.

Asthana[1] suggested that Diathane or Cuprovit reduced the incidence of disease but not fully. Ramakrishnan[2] and Choudhury[3] found that leaf-spot diseases caused by *Phyllosticta* could be controlled with Bordeaux mixture.

The present disease was not, however, amenable to it. Many mercurial and copper fungicides were tried at various intervals, both before and after artificial inoculations. Copper sandoz and Tillex were found more effective than any other but even these could not control the disease fully. Dusting within three days of inoculation gave more efficient control. The detailed results will be published in due course.

Botany Dept.,                    R. N. Tandon.
Univ. of Allahabad,              K. S. Bilgrami.
*August* 19, 1954.

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# NOBEL PRIZE FOR MEDICINE, 1954

THIS year's Nobel Prize for Medicine and Physiology has been awarded jointly to Drs. John F. Enders, Thomas Weller and Frederick Robbins, Poliomyelitis specialists at the Children's Hospital in Boston.

Dr. Enders is Associate Professor of Bacteriology and Immunology at the Harvard Medical School and Director of the Research Division of Infectious Diseases at the Children's Medical Centre, Boston. He was born at West Hartford on February 10, 1897. In World War I, Dr. Enders was a first lieutenant in Marine Aviation Corps. In World War II he served as Army Consultant on Epidemic Diseases. He was the recipient of Rassano Found Award for culturing poliomyelitis virus in living tissue in 1953.

Dr. Weller of the Harvard School of Public Health, and Dr. Robbins, a classmate of Dr. Weller at the Harvard Medical School, have been actively collaborating with Dr. Enders in his researches on poliomyelitis.

Dr. Enders in collaboration with Dr. Weller and Dr. Robbins developed a technique for growing polio virus in what was known as the "roller tube method". Before the work of Dr. Enders and his associates, it was practically impossible to produce polio vaccine in required quantity because of the dearth of the necessary isolated virus. They discovered that the virus could be grown *in vitro* or bits of living tissue taken from human beings or monkeys.

This provided a rapid and simple method for identifying different types of polio virus and for establishing whether a person has been infected.

During 1949, when the author visited their laboratory at Boston, they were using the embryonic tissue of freshly delivered still-born babies for the cultivation of polio and other viruses. The embryonic tissue is cut up into very small bits and a solution (modified Tyrode) is added to the embryonic tissue. Usually, penicillin (to prevent contamination) is also incorporated into the fluid medium. This tissue medium is inoculated with the virus material and incubated in flasks at 35° C. The fluid is renewed every 3 or 4 days and pooled and inoculated into mice, to assess the potency of the virus.

Prior to the work of Drs. Enders, Weller and Robbins, polio could be developed only in living monkeys. Virus obtained from infected monkeys was contaminated with monkey nerve tissue, from which it could not be successfully separated. A vaccine prepared from such contaminated virus was not considered suitable to be used as a prophylactic against poliomyelitis.

The new technique constitutes, therefore, a landmark in medical history. Since it was first announced in 1949, it has become one of the most effective weapons in the fight against polio and a host of other virus infections.

Y. S. Narayana Rao.

# REVIEWS

**Scientific Papers Presented to Max Born.** (Oliver & Boyd), 1953. Pp. vi + 94. Price 12 *sh.* 6 *d.*

Ten essays written by some of the foremost physicists adorn the volume under review and are offered as a tribute to Professor Max Born on the occasion of his retirement from the Tait Chair of Natural Philosophy. The list of contributors—Appleton, Bohm, de Broglie, Courant, Einstein, Jordan, v. Karman, Lande, Schrödinger and Weyl—itself bears ample testimony to the high esteem in which Born is held by theoretical physicists. As is to be expected, the topics of the essays are wide and varied. The article by Appleton on the influence of the earth's magnetism on the ionosphere, and that of v. Karman and Penner on the theory of explosive flames are the only ones which deal with experimental aspects of physics.

In a thought-provoking article (in German) Einstein examines the interpretation of the fundamentals of quantum mechanics, and some of his remarks have been critically discussed by Bohm. These and the articles of de Broglie on the interpretation of wave mechanics, of Lande on probability in classical and quantum theory, and of Schrödinger on relativity and wave-mechanics, all deal with the advancing front of contemporary physics. There is a very interesting paper by Jordan on the application of probability concepts of atomic physics in biology, particularly in relation to mutation and polyploidy. The two purely mathematical papers are by Courant on the classification of partial differential equations and by Hermann Weyl on the passage from complex numbers to numbers of an arbitrary field. The volume also contains a bibliography of Prof. Born's publications.

In a work of this character, the topics selected by the various contributors, being a reflection of their current interests, must range over a fairly wide field ; it is, however, significant that four of the papers deal with various aspects of the probability interpretation of quantum mechanics, which was due in its original form to Professor Born himself. These papers constitute a definite contribution to the understanding of a fundamental point in contemporary physics, and richly deserve to be studied by every serious student of physics.

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**Text-Book of Metallurgy.** By A. R. Bailey. (Macmillan & Co., London), 1954. Pp. viii + 560. Price 30 *sh.*

This book sets out to cover the whole field of metallurgy usually prescribed for university students. It has six chapters devoted to physical metallurgy, six to process metallurgy and one each to testing of metals and temperature measurements. In this respect, the framework of this book differs somewhat from some established favourites. However, it is one of the best the reviewer has come across. The impression that with such a wide field to cover, the treatment would be highly abridged and extensive supplementary reading has to be made, is quickly dispelled. The treatment is adequate throughout and in some cases, as in binary alloy systems, exhaustive. The list of books for further reading, carefully selected and appended to each chapter, is very useful.

The first two chapters deal with the crystal structure and atomic structure of metals, the treatment in general following that of Hume-Rothery. These are followed by two chapters on binary alloys. There is then a chapter dealing with the effects of stress on metals and one on the physical examination of their internal structure. The chapters on ore-dressing and the extraction and refining of non-ferrous and ferrous metals and alloys are followed by two more on casting and shaping processes. The two concluding chapters are on the testing of metals and temperature measurements. The treatment is throughout very clear. There are many line drawings, figures and photographs to help the student form a clear picture of what is explained. A number of binary equilibrium diagrams are given at the end and enable the student to form an idea at once of the complexity as well as versatility of many of these alloy systems. Detailed discussion of individual alloy systems is not possible in a book of this type and the author has wisely refrained from attempting to explain in detail even the metallography and heat treatment of steel. Although it is an advanced topic, the reviewer would have liked to see a short discussion on ternary

alloy systems and their representation, particularly because of the information given in Chapter 8 on free energy concepts and reactions in slag systems.

Not the least attractive feature of this book is the set of questions selected from university and other professional examinations, given at the end. This book will be most useful to students preparing for a first degree in metallurgy. It is neatly got up and its comparatively low price requires special mention.

E. G. RAMACHANDRAN.

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The Insulation of Electrical Equipment. Edited by Willis Jackson. (Chapman & Hall, London), 1954. Pp. 340. Price 42 *sh.*

The book is a compilation of lectures, by different authorities in the field of insulation and dielectrics, delivered at a post-graduate vacation school to assist young men in the sphere of insulation design.

The first chapter deals with a historical survey of the development of electrical insulation. The insulation designer is constantly faced with a range of conflicting practical requirements. Such problems and the properties of insulants which are relevant to the resolution of these problems are discussed in brief in the first chapter.

The next three chapters deal with the structural basis of the electrical and mechanical properties of insulating materials and with the mechanism of dielectric permittivity, loss and breakdown. The deterioration in service of insulating materials due to various factors such as oxidation, moisture, thermal and electrolytic effects, ionic discharges, etc., are discussed. An outline discussion of certain aspects of the above relevant to the sphere of insulation design has been made in these chapters. Chapter 5 deals with the classification of insulating materials by the International Electrotechnical Commission on the basis of the above.

The next five chapters are devoted one each to the discussion of the insulating materials actually used in present-day designs of communication components, power cables and capacitors, electrical machines, transformers and switchgear. The behaviour of the insulating materials both under normal and adverse conditions are discussed and the reasons for using the different insulating materials and their limitations in use are dealt with. The extent to which the synthetic insulating materials have been used in place of those processed from naturally occurring products and their limited

effect on the design have also been discussed. The chapter on insulation of power transformers deals mainly with core-type transformers. Suggestions have been made of the directions in which improvement in insulating materials and design would lie.

The last chapter deals with the important subject of insulation testing in the laboratory, factory and field. After dealing with the classification of tests in accordance with their functions, test methods and interpretation of test results are discussed. The author has laid emphasis on the fact that tests are not an end in themselves; they should be the means for determining fitness for service. He suggests that accepted tests should be reviewed regularly, while constantly bearing in mind the service conditions and, in particular, the time factor. A bibliography of up-to-date references of published literature is added at the end of each chapter.

The book provides a fundamental approach to the problem of the use and behaviour of insulating materials from the point of view of design and is bound to be useful to both design engineers and operating engineers.

C. S. GHOSH.

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Introduction to Dynamics. By L. A. Pars. (Cambridge University Press), 1953. Pp. xxii + 501. Price 50 *sh.*

This is an elementary treatise on the dynamics of a particle and of rigid bodies, useful for the student who has some knowledge of elementary statics and calculus and is intended to serve as an introduction to advanced treatises such as that of Whittaker. The first two chapters deal with the algebra and calculus of vectors and the third chapter is an exposition of the fundamentals of Newtonian dynamics based on Newton's three laws of motion. The author has taken great care to show how the subsequent development of the subject depends on these laws.

Chapters IV to XVII deal with particle dynamics and the remaining nine chapters are devoted to rigid dynamics, without using Lagrange's equations. Vector methods are used sparingly only where a distinct gain in elegance is achieved thereby. Moreover, its scope is very limited in two-dimensional dynamics, and with the view of focussing the attention on principles rather than methods, the author has relied on the two well-known devices of repetition and of going from the simple and concrete to the more general and abstract. At

the same time, the proofs and ideas are set out in a rigorous and clear way. The principle of reversibility on page 78, impulsive motion and collision of particles in Chapter VIII, the motion of a particle of varying mass in Chapter IX, the two chapters on central forces and the Chapter XVIII on the kinematics of two-dimensional motion deserve special mention as they contain some modern ideas. Two-dimensional rigid dynamics also, within the limits self-imposed by the author, has been expounded in an admirable way so as to rouse the interest of the student in the subject.

A number of diagrams are given and suitable examples are worked out to illustrate the underlying principle and numerous problems (nearly 500) are given in a graded manner as exercises for the student. On the whole this is a very interesting and modern text-book on elementary dynamics.

T. R. RAGHAVA SASTRY.

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**Facts, Files and Action, Part II.** (*Filing, Indexing and Circulation.*) By J. Edwin Holmstrom. (Chapman & Hall, London), 1953. Pp. xvi + 280. Price 32 *sh.*

The present volume is a logical sequel to Part I which dealt with the sources and backgrounds of facts (reviewed in this Journal 1952, 21, p. 145). In his introduction, the author observes that the documentation of facts for easy reference ought to be recognised as a profession in its own right, related to other professions in the same ancillary but vital way that librarianship is related to research or dietetics to hospital management. At present, however, it is only a few enlightened organisations that accord their registry or filing staffs a status and dignity commensurate with the importance of the key function they perform. Only by so doing is it possible to attract and retain men and women with the very special intellectual qualities needed to do it properly.

The varieties of methods available for filing and indexing which are dealt with in the book in the course of nine chapters will convince anyone of the truth of the author's remarks. Considering how very much the efficiency of an office, large or small, depends on proper integration and storekeeping of its records, it must be said that the author has rendered a distinct service by setting down the correct principles and rationale of these arts. The volume is heartily recommended for careful study and guidance by all those who have to rig up a system of artificial memory to make up for the shortcomings of the natural one.

**Vapour Pressure of Organic Com** [...] T. Earl Jordan. (Interscience [...] Inc.), 1954. Pp. ix + 266. Price [...]

In the volume under review the [...] compiled the available data on vap[...] of organic compounds from the pu[...] rature and presented them in a [...] form for the ready reference of all worker, chemist or a chemical en[...] data has been presented in three dif[...] (i) by giving tabulated values, (ii) priate graphs of vapour pressures [...] to temperature, and (iii) by giving [...] matical relationships of the form $(A - B)/(c + t)$ connecting the va[...] sure with temperatures in most of [...] Vapour pressure data compiled in[...] for hydrocarbons, halogen compo[...] hols, aldehydes, ethers, ketones, ox[...] nitrogen compounds, phenols, an[...] compounds containing arsenic, sel[...] phur, silicon, antimony, boron, gal[...] phosphorus, tin, thallium, beryllium [...]

Mention here may be made of the [...] cent volume *Selected Values of Phy[...] Thermodynamic Properties and Rel[...] pounds,* by the American Petroleum Research Product 44 published by Press, Pittsburgh, Pa, 1953. Data [...] T. Earl Jordan for hydrocarbons ar[...] agreement with those of American [...] Institute Research Project.

The book is recommended as a use[...] tion to any research library and as [...] asset to chemists and chemical engin[...]

G. S. I[...]

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**Sexual Behaviour in the Human Fem[...]** the Staff of the Institute for Sex [...] Indiana University. (W. B. Saund[...] Philadelphia, U.S.A.), 1953. Pp. x[...] Price 50 *sh.*

It was Dr. Alfred C. Kinsey who [...] tiated the research programme on the behaviour of *homo sapiens,* and the pr[...] had the staunch and generous suppo[...] Indiana University since its inception A Report on the Sexual Behaviour of the Male was published in 1948, the pre[...] being the second in the series. The [...] one of the most publicised documents from any laboratory. It has also bee[...] reviewed in the lay press of the U.S[...] elsewhere.

As a scientific treatise on what the la[...] regard as the most delicate of subj[...] Report is a great classic of its kind

no doubt be much sought after by marriage counsellors, sex consultants and others. Dr. Kinsey and his associates have made the best use of available data, collected with great difficulty and under promise of the strictest secrecy.

Of the adverse criticisms against the Report and these were many, only one need detain us here, and this is : to what extent the Report may be considered as truly representative of the entire class it seeks to speak about ? In regard to this point it may be categorically stated that no such pretensions were ever made by the authors of this Report, who have taken special care to avoid generalisations or conclusions, beyond what is perfectly defensible scientifically.

The volume is divided into three parts. The scope of the study and the methods employed in assessing the data on a scientific basis are indicated in the course of three chapters in Part I. Chapters IV to XIII on the types of sexual activity prevalent constitute Part II. Comparative studies of the anatomy, physiology, psychological factors, neural mechanisms and hormonal factors with reference to both the sexes are assigned a chapter each, and go to make up Part III of the volume.

As the authors themselves admit, a great deal more is yet to be known before pronouncements in regrad to sexual behaviour can be made with anything like the assurance possible in the physical sciences. But it cannot be gainsaid that a great beginning has been made here in this direction, and it is to be hoped that Dr. Kinsey and his associates will be given all the support and encouragement which they need to carry the project further and which, may we add, they have very well earned the right to expect, on the basis of these monumental Reports.

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Yeast Technology. By John White. (Chapman & Hall), 1954. Pp. 431. Price 55 *sh*.

This book, consisting of 22 chapters, is based on a series of papers entitled "Principles and Practice of Yeast Production', published in the *American Brewer* and on papers published in the *Journal of the Institute of Brewing*. Each chapter is devoted to a particular aspect of yeast such as classification, nutrition, mechanism of growth, methods of estimation of activity and factors in the industrial processes, etc. It is well supplied with 59 detailed tables and 71 plates, drawn from various research papers and organisations. The references to

the latest papers compiled at the end of each chapter provide a valuable source of information.

Most of the research work and the principles described in the book relate to the baking industry and the strain of Saccharomyces ; but the study of the reactions of this strain of yeast to various treatments will be of value to workers in other fields also. Readers in the brewing and distilling industries will find specific interest in a chapter on Brewers' Yeasts by C. Rainbow and in Chapter XVII on the microbiological control of yeast growth processes.

More elaborate details with regard to the use of the yeast in the pharmaceutical, wine and distilling industries will present a complete picture.

This is a useful handbook of information for all workers in yeast research and industry.

E. N. PARTHASARATHY.

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Discovery Reports, Vol. 26, Nos. 1-8. (Issued by the National Institute of Oceanography.) (Cambridge University Press), 1954. Pp. vi + 354. Price 99 *sh*.

This volume which took over three years to complete, contains 8 articles from Robert Clarke, Hjalmer Broch, A. W. B. Powell, Grace E. Pickford, E. J. Iles and S. G. Brown and is illustrated by 62 text-figures and 18 plates.

*Ceratias holbolli*, an angler-fish with adjustable fish lure, was recovered from the stomach of a sperm whale. Its toxonomy and allometric growth (suggesting that this may be the adult of *Mancalias*) are discussed. Its being found at 1,000 m. in the tropics and at 120 m. in higher latitudes is likely to be due to factors of light intensity rather than temperature, and therefore it is not likely that the cold Polar current forces it to the surface. Species of stylasterid corals from the antarctic are described. The study of antarctic and subantarctic pelecypods and gastropods shows that the bulk of them could have been derived from those of the Americas and that the occurrence of stenothermic gastropod genera like *Aforia* and *Fusitriton* of Arctic waters, must be due to a bipolar distribution. The octopod collection is of interest in showing that Vampyroteuthis population of the Indian Ocean are confluent with those of the Atlantic and the Pacific Oceans round South Africa and south of Australia. It occurs between 500 m. and 1,000 m. and is limited to narrow salinity, density and temperature range. The pelagic Ostracods of

the Benguela current are of interest since their depth distribution shows nocturnal migration to surface. The papers on open boat whaling in the Azores and on the dispersal and migration of blue and fin whales add considerably to our knowledge of whaling as a commercial proposition.

This volume, like the rest of the *Discovery Reports* will form a valuable addition to any Zoological library.

C. P. GNANAMUTHU.

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The Vitamins. (*Chemistry, Physiology, Pathology.*) Vol. I. Edited by W. H. Sebrell, Jr. and Robert S. Harris. (Academic Press, Inc., New York), 1954. Pp. xiii + 676. Price $16.50.

Recent advances in the field of vitamins have been so rapid and extensive that the existing books on this subject appear to be rather out of date. This volume, which is the first in a series of three volumes is intended to give an exhaustive account of the chemistry, physiology and pathology of vitamins and will, therefore, be welcomed as a very timely publication. The comprehensiveness in regard to the treatment of the subject may be understood from the fact that only four vitamins have been described in 618 printed pages, the treatment being accompanied by extensive references to world literature and by profuse illustrations with diagrams, tables and photographs.

The vitamins which have been taken up in alphabetical order and described here are: (*i*) vitamins A (and carotenes), (*ii*) ascorbic acid, (*iii*) vitamin $B_{12}$, and (*iv*) biotin. A notable feature of the volume is that each vitamin is not dealt with by any single individual but by eight or more specialists, who could speak authoritatively on certain sections by virtue of their research contributions. As the Editors state in their preface, 'this method will force the reader to change guides as he progresses through each chapter, but it will assure a higher level of competence'. Thus, a chapter dealing with a certain vitamin has, with minor variations, been treated under separate headings such as nomenclature and formula, chemistry, industrial preparation, biochemical systems, biogenesis, estimation, standardization, occurrence in food, effects of deficiency, pathology, pharmacology and requirements. Methods of synthesis of vitamins have been given in great detail; biochemical functions have been described in so far as they are understood at the present time, and due emphasis has been laid on vitamin deficiency conditions, particularly in experimental animals and birds. A few minor mistakes have been noticed in literature references 6 and 7 on page 212, and in reference 43 on page 618, which may be corrected in future editions. In the reviewer's opinion, this volume is an exceedingly fine compendium on every conceivable aspect of the four vitamins mentioned above, and though the price is rather on the high side, it should find a place on the bookshelf of all those who are interested in the subject of vitamins.

P. S. SARMA.

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Books Received

*Sex in Micro-Organisms.* Edited by D. H. Wenrich, I. F. Lewis and J. R. Raper. (AAAS, Washington 5, D.C.), 1954. Pp. v + 362. Price $5.75.

*Wave Motion and Vibration Theory,* Vol. V. (Proceedings of the Fifth Symposium in Applied Mathematics of the American Mathematical Society). Edited by A. E. Heins. (McGraw-Hill), 1954. Pp. v + 169. Price $7.00.

*Representative Chordates.* (A Manual of Comparative Anatomy). By Charles K. Weichert. (McGraw-Hill), 1954. Pp. vii + 204. Price $3.50.

*Genetic Homeostasis.* By I. Michael Lerner. Oliver & Boyd—Macmillan, London), 1954. Pp. vii + 134. Price 12 *sh.* 6 *d.*

*Animal Cytology and Evolution.* By M. J. D. White. (Cambridge University Press), 1954. Pp. xiv + 454. Price 45 *sh.*

*The Chemical Pathology of Animal Pigments.* (Biochemical Society Symposia No. 12.) Edited by R. T. Williams. (Cambridge University Press), 1954. Pp. 84. Price 12 *sh.* 6 *d.*

*Inorganic Chemistry.* By H. D. Gehani and S. M. Parekh. (Educational Publishing Co., Bombay-4), 1954. Pp. 724. Price Rs. 10.

*A Course of Practical Physics.* By N. V. Kogekar and R. D. Gupte. (Educational Publishing Co., Bombay-4), 1954. Pp. 184. Price Rs. 4.

*First Course in Physics.* By R. D. Godbole, M. G. Mahajan, R. D. Gupte. (Model Publishing House, Bombay-4), 1954. Pp. 390. Price Rs. 6.

*Weeds in Indian Agriculture.* By C. Thakur. (Motilal Banarsidass, Bankipur, Patna), 1954. Pp. xv + 125. Price Rs. 7-8-0.

# SCIENCE NOTES AND NEWS

*Cercospora* Leaf-Spot of *Tinospora cordifolia* Miers.

K. A. Mahmud and Husne Ara Khatun, Department of Biology, University of Dacca, Dacca, report as follows:

Leaf-spot disease of *Tinospora cordifolia* Miers. due to *Cercospora tinosporœ* Syed., previously reported from the Philippine Islands (1916) and Ahmedabad (1935), was observed at Dacca in October 1953. The symptoms of the disease and the morphological characters of the pathogen were similar to those described by Sydow (1916) and Agrekar (1935). Inoculation tests gave positive results.

## Nuffield Foundation Travelling Fellowships

Applications are invited from Indian Graduates for the Travelling Fellowships in Medical Sciences (Preventive and Social Medicine, and Genetics or Ophthalmology), Natural Sciences (Fundamental Studies in Mathematics or Physics or Dynamical Meteorology with Special Reference to Weather Forecasting), Engineering (Tele-Communication with Special Reference to Recent Developments or Metallurgical Engineering) and Social Sciences (Social Accounting with Particular Reference to Recent Developments in Techniques or Land Utilization and Management in Relation to Agricultural Planning) to be awarded by the Nuffield Foundation for 1955-56.

Copies of the announcement relating to the awards, and the application form can be had on request from the Secretary, Nuffield Foundation Indian Advisory Committee, Darbhanga House Annexe, 25, Akbar Road, New Delhi. The application (5 copies) is to reach the Secretary by January 15, 1955.

## Zeitschrift für Kristallographie

After an interval of almost ten years, publication of the *Zeitschrift für Kristallographie* will be resumed. The publishers, Akademische Verlagsgesllschaft, m.b.H., Frankfurt am Main, announce that Volume 106, Number 2, will be released during October 1954.

Professors M. J. Buerger (Massachusetts Institute of Technology), F. Laves (Mineralogisch-petrographisches Institut der Eidg. Techn. Hochschule, Zurich), G. Menzer (Universitätsinstitut für Kristallographie und Mineralogie, München), and I. N. Stranski (Technische Universität, Berlin-Charlottenburg) have agreed to serve as editors of the journal.

Articles will be printed in German, English, French, and Italian. The *Zeitschrift für Kristallographie* will be published irregularly. One volume will consist of six issues, priced individually. (The price per volume will be approximately $ 16.65 or about DM 70.00.) Orders and inquiries about the *Zeitschrift* should be addressed to the publishers, Akademische Verlagsgesellschaft, m.b.H., Holbeinstrasse 25-27, Frankfurt am Main, Germany.

## European Organization for Nuclear Research

The programme for the European Organization, ratified by a recent convention, includes the construction of a modern laboratory in Geneva for research in high energy particles. The laboratory will be equipped with large accelerators, a 600 Mev. synchro-cyclotron and a 25 proton synchrotron. The latter will be the most powerful machine in the world; it will reach energies ten times greater than the Brookhaven (U.S.A.) cosmotron and five times greater than the Berkeley (California) bevatron now under construction. The building of the laboratory and the apparatus is estimated at a hundred million Swiss Francs and will take seven years to complete.

The Organization will be responsible for international collaboration in research on the behaviour and composition of atomic nuclei and will investigate the relations between matter and energy by the study of individual neutrons, protons and other elementary particles such as those in cosmic rays. It will also undertake the training and exchange of scientists.

Prof. Felic Block, formerly of the Institute of Physics of Stanford University (U.S.A.), is to be the Director of the Organization. The creation of the Geneva Laboratory will provide European scientists with a research centre fully capable of dealing with contemporary scientific problems.

## Wind Energy Research in Israel

Extensive research in the use of wind energy is now under way in Israel. Since 1953, a small windpower electric plant has supplied current for public buildings at Eilat on the Red Sea. Another plant is installed at Nebi Yosha, in Galilee. Eighteen observation posts have been set up to measure wind velocities

in different parts of the country by the Israel Scientific Council, with the technical assistance of UNESCO. It is expected that new installations will permit important savings in fuel and money.—UNESCO.

## Institute for Nerve Research at Venezuela

A scientific centre for basic research in the field of neurology is to be established near Caracas, Venezuela. The Institute, one of the largest in the world, will include twelve central departments and is planned as a training centre for young scientists from the whole of Latin America, while leading specialists from all over the world will be invited as lecturers. Its programme will include neuro-physiology, bio-chemistry, embryology as well as cybernetics, etc. The Head of the new Institute is Professor Humberto Fernandez-Moran, the well-known neurologist and cytologist.

## Molybdenum Disulphide as Lubricant

Molybdenum disulphide is a valuable special service lubricant in that it can be used at much higher temperatures and pressures, and also at rather lower temperatures than oils and greases. Chemically, it is strongly resistant except to oxygen, chlorine, fluorine and very strong acids. Whilst its adjacent molecular layers can slide easily over one another, its boundary layers adhere firmly to metals and to rubber. It builds up a layer of limited thickness only, so that overlubrication is unlikely to occur. Lubricated metal surfaces are kept apart under loads up to 350,000 lb./sq. in. It maintains good lubricant properties over a temperature range of $-100°$ to $750°$ F.; above this it is oxidised unless oxygen is excluded, in which case the upper temperature limit is about 2,000° F.

## Diffusion Method of Treating Timber

The diffusion method of impregnating sapwood timber with boric acid and borax, developed by New Zealand scientists sometime ago, has proved commercially successful and cheap. A method that saves much of the handling costs at the treatment stage has now been worked out and successfully tested on *Pinus radiata* in the laboratory.

Freshly-sawn green 1″ and 2″ *Pinus radiata* only were used throughout the tests, but it is believed that the method may be suitable for sapwood of other timber species provided adjustments are made to the treatment. To be effective as a preservative, a minimum of 0·2 per cent. of boric acid must reach the core of the timber, and many factors influence suc-

cessful impregnation, the main ones of which are thickness of the timber and its moisture content and density, the concentration of the treating solution, and the time allowed for diffusion before the timber is dried and handled in the normal way. The recommendations issued to commercial firms adopting this method, however, will enable the plant operator to make full use of the principles involved. (Information Bureau, D.S.I.R., New Zealand.)

## New Type Lens for Clearer Vision

"Clear image" glasses were demonstrated recently before the Kentucky Optometric Association by their inventor, Dr. William Feinbloom, a Professor at Columbia University, New York.

Dr. Feinbloom describes his new lens as being "something like a telephoto lens with a wide vision". It would appear that for the first time the principles of aspherical surfaces are employed as an aid to the human eye. These surfaces are departures from the spherical surfaces found in ordinary spectacles or magnifying glasses. Thus, instead of being curved like a ball or sphere, the new lens is slightly flattened or parabolic (aspherical) towards the edges.

## Role of Allergies in Heart Ailments

During the Second World Congress of Cardiology held recently, it was reported that the human heart can be allergic to a wide variety of external irritants. Allergic reactions of the heart can be responsible for serious and sometimes even fatal illness.

Manifestations of heart allergy may vary from disturbances of the rate and rhythm of the heart beat, to severe chest pains, coronary heart disease or damage to the heart muscle tissue. Among substances which affect the heart are tobacco, salicylates (aspirin), penicillin, pollen, some foods, and bacterial infections.

## Symposium on Biochemistry of Vitamins

Under the joint auspices of the Society of Biological Chemists, India, Royal Institute of Chemistry (Deccan Section), Indian Medical Association (Bangalore Branch), and Indian Dairy Science Association, a symposium on "Recent Advances in the Biochemistry of Vitamins" will be held during the Easter for 1955. Abstracts of papers relating to (a) methods in vitamins research, (b) biological role of vitamins, (c) vitamins in nutrition and medicine, and (d) vitamins in food technology, may be sent to the Hon. Secretary, Society of Biological Chemists (India), Indian Institute of Science, Bangalore-3, before 31st January 1955.

## AMETHYST: ITS NATURE AND ORIGIN*

AMETHYST is a variety of crystalline quartz which, instead of being colourless and transparent like the ordinary form of rock-crystal, exhibits a beautiful purple colour, in consequence of which it has been esteemed as a gem-stone since ancient times. Mineralogists have naturally been much interested in the question of the origin of this colour. Problems of the same nature arise in regard to numerous other minerals and it was customary in the past to explain the colour in such cases as due to impurities assumed to be present in the material and diffused through it in an atomic or a colloidal form. A different view regarding the origin of colour in many minerals has latterly been gaining favour, namely, that it is a consequence of defects in the regularity of structure such as would be caused, for example, by the crystal having been subject over long periods of time to radiations traversing its substance. Explanations along one or the other of these two lines are to be found in the extensive literature concerning amethyst, but it can

scarcely be claimed that they are based on evidence of a convincing nature. Still another view regarding amethyst which for a long time held the field is that it consists of quartz in which layers of the right-handed and left-handed varieties alternate. Why such alternation should result in colour is a question which was left unanswered.

The problem of amethyst has been under investigation at my Institute in Bangalore during the past year and conclusions regarding the nature of this material have been reached which are different from anything which has been so far suggested. They are based on the results of fact-finding research on those properties of amethyst which appeared to us most likely to throw light on its physico-chemical constitution.

The first series of studies undertaken by Mr. A. Jayaraman and myself were precise measurements of the density of amethyst quartz. For such measurements to have scientific value, it is necessary to work with selected material free from cracks, inclusions and visible impurities. Accordingly, cut and polished gem-stones believed to be of Ceylonese

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* Presidential Address delivered at the Annual Meeting of the Indian Academy of Sciences held at Belgaum on the 26th of December 1954.

origin were used for the determinations. The specimens employed varied notably in their depth of colour. Differences of the order of one or two units in the third decimal place were indeed noticed in their densities, but such differences exhibited no correlation with the depth of the colour of the specimen; neither did the values differ significantly from that of colourless quartz.

Careful studies have also been made regarding the behaviour of amethyst in magnetic

ing. Clear quartz of the best quality does indeed exhibit light-scattering, but this is extremely feeble. In smoky quartz, on the other hand, a Tyndall effect is very conspicuous. But in amethyst no such phenomenon is observable. The difference is illustrated in Fig. 1 in which the tracks of a beam of sunlight in smoky quartz and in amethyst are exhibited side by side, the specimen in each case being immersed in a cell containing benzyl alcohol to avoid refraction effects.
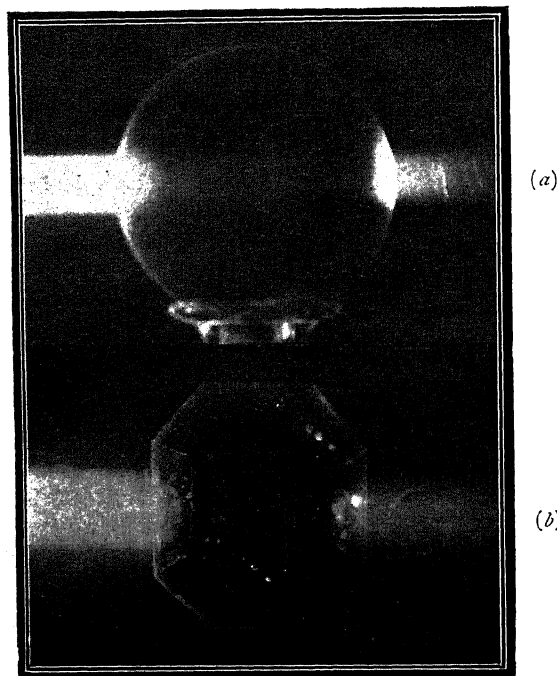


FIG. 1. (*a*) Smoky Quartz; (*b*) Amethyst.

fields. Quartz is diamagnetic, and exhibits a very feeble diamagnetic anisotropy. Metallic oxides such as those of manganese or iron to which the colour of amethyst has been attributed in the past are highly paramagnetic and hence, if present, might be expected to reveal themselves by an altered magnetic susceptibility. Here again our results were entirely negative. All our amethyst specimens were diamagnetic and their susceptibility showed no significant variations from that of colourless quartz.

The next property investigated was the scattering of light in its passage through the solid. As is well known, this is a severe test of the regularity of the structure of the material and of the absence of inclusions, the latter, if present, revealing themselves immediately by a largely enhanced intensity of light-scatter-

Thus we are led to the view that amethyst is a crystal with a regular structure and that the cause of the colour is to be looked for in the ultimate constitution of the crystal itself. This view is independently confirmed by the results of research in two other and quite different directions. The first is a study of the X-ray diffraction by amethyst carried out by Mr. Jayaraman and myself, and the other, a detailed investigation of its optical properties by Mr. S. Pancharatnam. I shall now proceed to summarise the findings reached.

In view of the close association of colourless quartz and amethyst as found in nature, one could scarcely expect to find any readily measurable differences in the spacings of their three-dimensional crystal lattices. What we have to look for are differences in the electronic distribution and therefore also the reflecting

powers for X-rays of the lattice planes in the two crystals. To establish the existence of such differences by the usual methods followed in X-ray structure determination would obviously be laborious and might even be infructuous. We have therefore employed a method which has proved itself to be both simple and effective. The section-plate of amethyst finally chosen for the study was cut obliquely to the optic axis of the quartz and by etching tests was ascertained to be free from either optical or electrical twinning over its effective area. It however exhibited a pattern of colour bands and colour sectors of the kind almost invariably to be seen in amethyst. The section-plate was irradiated by an X-ray pencil over its whole area and gave a Laue pattern in which each Laue spot was itself an

gonal symmetry as in the case of colourless quartz. The studies have also revealed that the diad axis of monoclinic symmetry coincides with one of the three electrical axes of the associated quartz. The latter is different for the three colour-sectors usually observed in a section-plate of amethyst, their diad axes being inclined to each other at an angle of 120°.

Whereas it has hitherto been supposed that amethyst exhibits a single absorption band in the green region of the spectrum, Pancharatnam has found that there are three different absorption spectra differing enormously in the strength as well as in the position of the absorption band, corresponding to the vibrations along the three colour axes within the crystal. The weakest of the three absorptions is for vibrations along the diad axis; the absorp-
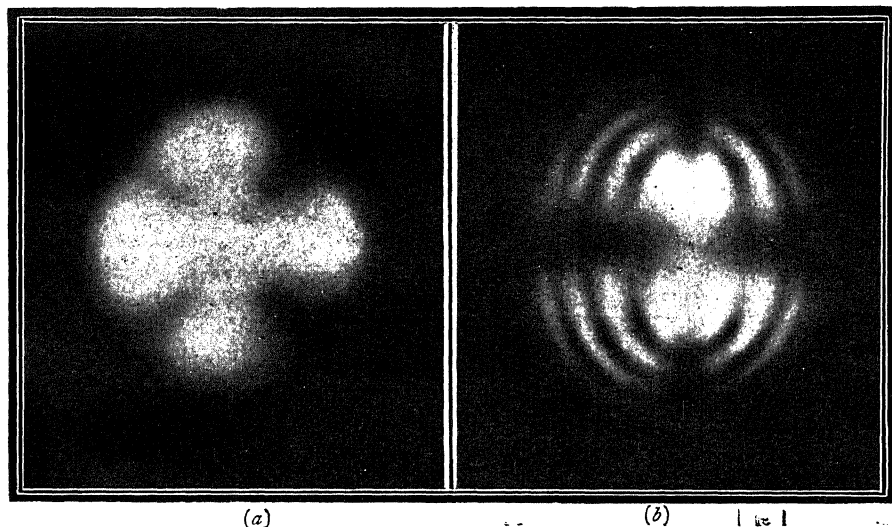


FIG. 2. (a) Idiophanous figure; (b) Biaxial figure

extended picture of the crystal. It was found that the Laue spots also exhibited the features optically observable in the section-plate but in a very different way in the different spots, thus clearly showing that the variations in the colour observed over the area of the plate correspond to variations in the X-ray reflecting power which are different for the different lattice planes, as is to be expected on the foregoing view regarding the nature of amethyst.

The optical investigation by Mr. Pancharatnam has also yielded highly significant results. They may be summarised by the statement that amethyst is optically biaxial, that it exhibits trichroism and that these two properties taken together show amethyst to possess only monoclinic symmetry instead of tri-

tion maximum for it is near 5000 Å and the transmitted light is light orange in colour. The two other colour axes lie in a perpendicular plane and make angles of about 45° on either side of the trigonal axis of quartz. For one of them the absorption is particularly intense and is centred round 5250 Å, the transmitted light being a deep reddish purple. For the third axis, the absorption maximum is near 5750 Å and the transmitted light is blue in colour.

Figs. 2 (a) and (b) respectively are photographs of the so-called idiophanous figure of absorption exhibited by amethyst in convergent unpolarised light and of its biaxial figure as seen between crossed polaroids. The former figure was photographed in the green monochromatic light of a mercury lamp and

the latter in deep red light, the crystal in both cases being viewed along the trigonal axis of the quartz.

Very small and not improbable displacements of the silicon atoms along the electric axes on which they lie would suffice to alter the trigonal symmetry of colourless quartz to the monoclinic symmetry of amethyst. The accompanying deformation of the oxygen tetrahedra surrounding each silicon atom would offer a pathway to the explanation of the pleochroism exhibited by amethyst. We shall not pause here to discuss these points in further detail,

served separated from another which is comparatively free from colour by internal planes parallel to the external rhombohedral faces of the crystal. X-ray shadowgraphs of the specimens disclose that along the boundary between these two portions of the material, there is invariably a deposit of fine particles which chemical examination reveals to be ferric oxide. The conclusion is thus almost irresistibly suggested that amethyst is formed from silicious material containing ferric impurities and is consequent on the progressive elimination of these impurities during the growth of the crys-
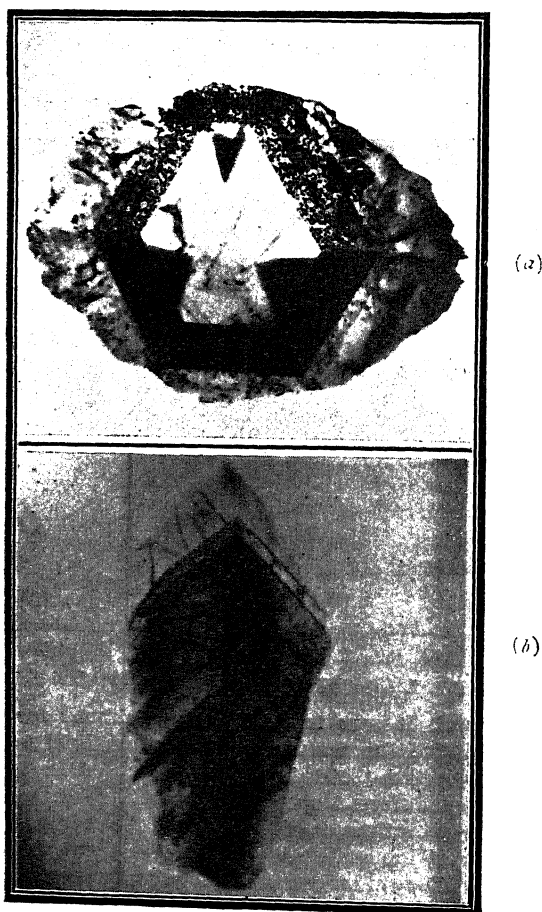


FIG. 3. (*a*) Transverse section; (*b*) Complete crystal.

but will pass on to consider the very interesting question as to the circumstances in which silica crystallises as amethyst instead of as colourless quartz. The study of a great number of specimens collected from near Hyderabad City in South India points to certain conclusions regarding this matter. A feature very commonly observed in the individual specimens is that a region of intense colouration is ob-

tal. At some stage in the process, the impurities separate out into distinct particles, and then cease to play any further role in the crystallisation, which accordingly continues as clear quartz. Figs. 3 (*a*) and (*b*) illustrate the foregoing remarks. The former is a section-plate cut perpendicular to the trigonal axis; the hexagonal ring containing the ferric oxide particles is very conspicuous and surrounds the

inner region of quartz in which the three colour sectors adjacent to the three of the rhombohedral faces are clearly seen. Fig. 3 (b) is a picture of an entire small crystal of amethyst immersed in benzyl alcohol and viewed transversely by sodium light. Regions of colourless and coloured quartz are clearly seen in the picture, separated from one another by a sharply defined boundary which carries a dark deposit of ferric oxide.

C. V. RAMAN.

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## PRINCIPLES OF OPTICAL ENGINEERING*

IN unravelling the mysteries of both the atomic and the astronomical worlds, no branch of physics has played a greater role than optics. But for the development in precision optical technique which has enabled the construction of spectrographs, microscopes and telescopes, our knowledge of the physical world would not have been what it is. The optical instrument, instead of being merely a laboratory appliance, has crept into the field of mechanical engineering where the highest precision is attained only by optical devices. In aerial surveying, in accurate artillery, in fine art photography, in cinematography, in biological investigations, and in a variety of branches of human activity, optical equipment is becoming more and more predominant. From all aspects of scientific advancement, there is an increasing demand not only for a larger and larger number of new optical components, but also for improved techniques in the attainment of greater perfection in the production of these components.

It is however surprising that the literature on such an important subject as optical workshop technique is so meagre. This is probably due to the fact that manufacturers in this line were reluctant to part with their technical secrets.

The foremost in the field to get out of this traditional reticence was Charles Deve with the publication of his classical work "Travail des Verres d' optique de Precision" in 1938. The book was written with a double purpose—firstly, as a text for trainees in optical workshop principles and, secondly, as a book of reference for works managers and senior workmen. This treatise was found to be of such importance, that two more editions were brought out even during the most difficult conditions of World War II. M/s. Adam Hilger got it translated into English, and the volume under review is the second English edition of the book published by them.

From the fundamental notions of glasses and their faults, of abrasives and their gradations, of tools and their proper uses, to the most difficult art of obtaining and testing of optical components of the highest precision, the book covers the entire range of the technique of workshop optics. Deve has, for the first time, developed a coherent theory of surfacing, from which he deduces rules for workshop procedure, a practice which has been hitherto based merely on experiment and experience. It is this theory that enabled solution of a number of unsolved optical problems including the very complicated production of perfect cylindrical surfaces. In this work, precision optical technique, which was considered to be an art and a monopoly of the gifted few, is developed and treated as a scientific subject and made available to all who choose to take to this line. All aspects of manufacture of optical components including grinding, polishing, centering and edging, as well as of the allied aspects of cementing and metallising are treated in a clear and lucid manner.

An important addition in this edition of the book is the production of aspherical surfaces and contact lenses, achievements which were outstanding for generations. There is no aspect of the subject that is not dealt with, excepting that of the treatment of crystals, the technique of which could have been described in greater detail. Probably that was not in Deve's line of work, nor was he spared to live to contribute to the latest developments in this.

In the words of Ch. Fabry, who was Deve's patron and guide, "the working optician, as well as the apprentice, the foreman and the technical directors will find in this book ample matter for self-instruction and although they find difficulty in properly assimilating certain parts, will be well repaid for their pains, by a more complete understanding of a difficult art, one of the most beautiful that there is".

Hilgers have done a distinct service to the English-knowing scientists by bringing out this translation, which is a faithful reproduction of the original.

I. RAMAKRISHNA RAO.

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* *Optical Workshop Principles.* By Charles Deve. 2nd English Edition. Translated by T. L. Tippcell. (Hilger and Watts Ltd.), 1954. Pp. xxiv+436. Price 42 *sh.*

# NEW MICROFORAMINIFERA FROM THE ORBITOLINA-BEARING ROCKS OF TIBET AND BURMA*

M. R. SAHNI AND V. V. SASTRI

*Geological Survey of India, Calcutta-13*

RECENTLY, while engaged on a monograph of the orbitolines found in India, Pakistan, Tibet and Burma (to be published in the *Palaeontologia indica*), the authors' attention was drawn to a number of foraminifera of minute size occurring in association with these orbitolines. Although some of these microforaminifera possess the general pattern of known genera of much larger size, absence of agglutinisation in the strict sense of the term which characterises most of their larger counterparts, proves that the apparent parallelism is no evidence of genetic relationship; also, that their dwarfism is not related to such factors as food, temperature of water, chemical composition, pH concentration, light, etc., because the associated larger foraminifera, consisting mainly of species of *Orbitolina*, are all of normal size. The dwarfism of the microforaminifera is thus inherent in the forms and quite independent of external stimuli and environment. Microforaminifera that would pass through a mesh of the size normally used for separating foraminifera have already been isolated from Tertiary rocks and recent faunas by Hoffmeister and Berry[1] and Wilson and Hoffmeister[2] while the causes of dwarfism have been discussed by several authors, among them Preston Cloud,[3] Dawson,[4] Kidder and Stuart,[5] Kidder, Lilley and Claff,[6] Lalicker,[7] Moore[8] and Scott.[9]

It was very clear that dwarfism of the microforaminifera briefly described below could not have been produced by the above mentioned factors. New generic and species names have, therefore, been proposed for them. Further work on the forms occurring in all the *Orbitolina* horizons reviewed in our monograph referred to above, is in progress.

Descriptions of the genotypes supplement the brief generic diagnoses here given. Further details are being given in a more exhaustive paper. Since the exact relationships of the genera here described are uncertain, they have not been assigned family position.

## Genus *Yanbonia*, nov.

Genotype *Yanbonia moniliforme*, sp. nov.

*Generic Diagnosis.*—The only known species is uniserial; chambers bulbous with aperture situated centrally. For further details see description of the genotype below.

*Description of Genotype.*—Test uniserial, thick-walled, free, elongate, tapering towards the initial chamber; chambers subspherical, arranged in a rectilinear series; sutures straight, at right angles to the axis. The aperture appears to be terminal judging by a change in the contour along the median line of the later formed chambers.

*Dimensions.*—Maximum length, ·5 mm.

*Age.*—Cenomanian; U. Burma.

## Genus *Kutaungia*, nov.

Genotype *Kutaungia cretacea*, sp. nov.

*Generic Diagnosis.*—Forms initially biserial, becoming uniserial in later stage. The only known species possesses three subdepressed chambers in the uniserial stage.

*Description of Genotype.*—Test biserial in the earlier stages, becoming uniserial later; free, elongate, tapering gradually; biserial stage consisting of three to four chambers, with a solitary, more or less circular chamber initially, which might be the proloculum. Uniserial stage consisting of three chambers, which number is constant both in the Burmese and Tibetan specimens. The uniserial chambers are flattened and the sutures are more or less at right angles to the median longitudinal axis; aperture not visible.

*Dimensions.*——Maximum length, ·2 mm.

*Age.*—Aptian-Cenomanian; U. Burma.

## Genus *Hukawngia*, nov.

Genotype *Hukawngia problematica*, sp. nov.

*Generic Diagnosis.*—Forms initially coiled, becoming uniserial in later stages; chambers subdepressed; the uniserial stage consists of four chambers in the only known species.

*Description of Genotype.*—Test free, early chambers planispiarally coiled, later ones uniserial and rectilinear. There appear to be five to six chambers in the coiled portion; aperture not observed.

*Dimensions.*—Of the two specimens, one measures ·2 mm. and the other ·3 mm.

*Age.*—Cenomanian; U. Burma.

## Genus *Irrawaddia*, nov.

Genotype *Irrawaddia trigonalis*, sp. nov.

*Generic Diagnosis.*—Forms biserial with chambers increasing more or less rapidly in size in later stages, producing, in some cases (as in the genotype), a sharply triangular outline in section.

*Description of Genotype.*—Test free, elongate, increasing rapidly in later growth stages; arrangement of chambers typically biserial; sutures straight in the early stages, becoming more or less incurved obliquely later.

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*Dimensions.*—Maximum length, ·5 mm.

*Age.*—Cenomanian ; U. Burma.

### Irrawaddia tibetica, sp. nov.

Test free, elongate, tapering, chambers biserial throughout, sutures run oblique to the axis. There are six to seven chambers in each row ; aperture not observed.

*Dimensions.*—Maximum length approximately, ·25 mm.

essential characters of the genus. It is widely distributed geographically having been found in areas as far removed from each other as Khan-Sang La, in Tibet and Maingtha Chaung and Ku Taung, in Burma. This wide geographic distribution is likely to prove of great value in correlation.

*Dimensions.*—Maximum length, ·6 mm.

*Age.*—Aptian-Cenomanian ; U. Burma.
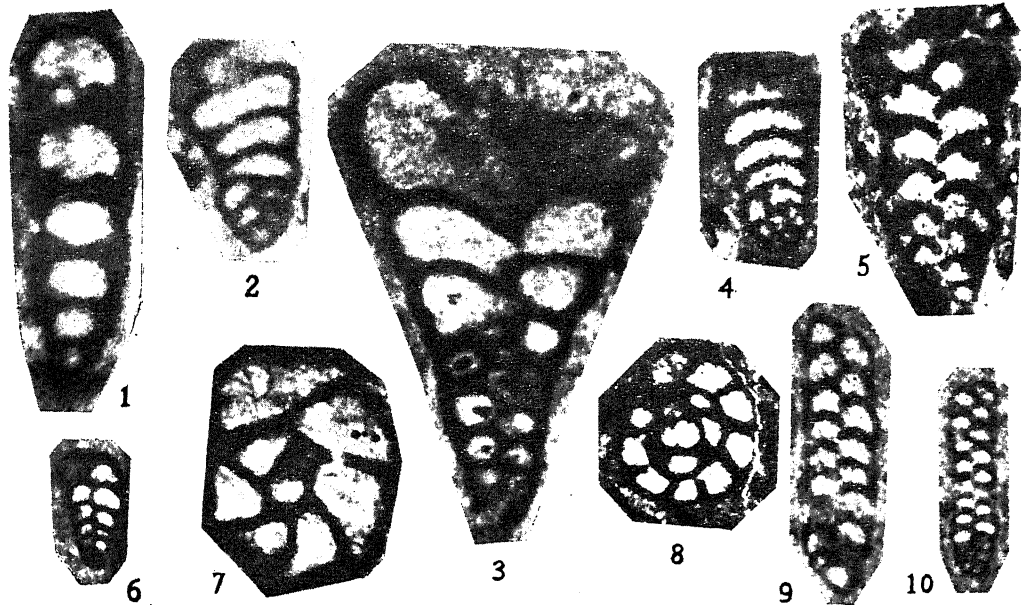


FIG. 1. *Yanbonia moniliforme,* gen. *et* sp. nov., × 100. FIG. 2. *Kutaungia cretacea,* gen. *et* sp. nov., × 125. FIG. 3. *Irrawaddia trigonalis,* gen. *et* sp. nov., × 120. FIG. 4. *Hukawangia problematica,* gen. *et* sp. nov., × 125. FIG. 5. *Mesania tibetica,* gen. *et* sp. nov., × 125. FIG. 6. *Irrawaddia tibetica,* sp. nov., × 68. FIG. 7. *Kyatsokia tibetica,* gen. *et* sp. nov., × 140. FIG. 8. *Kyatsokia multilocularis,* sp. nov., × 105. FIG. 9. *Mesania vermiforme,* sp. nov., × 124. FIG. 10. *Mesania kutaungensis,* sp. nov., × 45.

*Age.*—Aptian-Cenomanian ; Tibet.

### Genus Mesania, nov.

Genotype *Mesania vermiforme,* sp. nov.

*Generic Diagnosis.*—Forms biserial (rectilinear or conical) with chambers of more or less uniform size, except in early stages ; sutures concave towards the initial chamber, as a rule.

*Description of Genotype.*—Test free, narrow, elongate, straight, biserial throughout, of uniform width except in the initial stage ; nine to ten chambers constitute each row ; sutures deeply incurved and uniformly thick ; initial portion of shell slightly conical.

*Dimensions.*—Maximum length, ·3 mm.

*Age.*—Barremian-Aptian ; U. Burma.

### Mesania kutaungensis, sp. nov.

Test narrow, elongate, biserial ; sutures slightly incurved. This form possesses the

### Mesania tibetica, sp. nov.

Test free, elongate, biserial, gradually tapering, with eight chambers in each row ; sutures incurved and tending to thicken at marginal junctions. The internal characters exhibited by this form appear to justify its reference to the genus *Mesania,* in spite of its rather tapering charatcer.

*Dimensions.*—The holotype measures ·4 mm. in length.

*Age.*—Aptian-Lower Cenomanian ; Tibet.

### Genus Kyatsokia, nov.

Genotype *Kyatsokia tibetica,* sp. nov.

*Generic Diagnosis.*—Forms coiled, with chambers disposed more or less as in rotalids ; test calcareous ; number of whorls varying from one and a half to two and a half ; chambers increasing very gradually in size.

*Description of Genotype.*—Test calcareous, free, trochoid, rotaliform, consisting of one and a half whorls; sutures disposed obliquely to the axis of coiling, not deeply incurved; last whorl formed of six chambers.

*Dimensions.*—Maximum length, ·25 mm.

*Age.*—Aptian-Cenomanian ; Tibet.

*Kyatsokia multilocularis,* sp. nov.

Test made up of two-and-a-half whorls, the last formed consisting of nine chambers. This is a more tightly coiled form than *K. tibetica,* just described; sutures slightly obliquely disposed. A fairly large-sized initial chamber appears to be present in the central portion of the test.

*Dimensions.*—Maximum length, ·2 mm.

*Age.*—Aptian-Cenomanian ; Tibet.

The stratigraphic ranges assigned to the foregoing species are determined from those of the orbitolines with which the microforaminifera are associated.

The holotypes of all the species described above are preserved in the Geological Survey of India.

A detailed paper on these forms will be published in due course.

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7. Lalicker, G. G., *J. Sed. Petr.,* 1948, **18,** No. 2, 51. Pl. 1, Fig. 1.
8. Moore, R. C., *Ibid.,* 1948, **18,** No. 3, 126.
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# OBITUARY

## DR. M. A. GOVINDA RAU

THE death of Dr. M. A. Govinda Rau, Director, Alagappa Chettiar College of Technology, Madras, on November 19, has removed one of the pioneers in the field of chemical engineering in the country, and will be widely mourned by those who had the good fortune to know him.

M. A. Govinda Rau was born on 26th August at Viswammalsamudram in Trichinopoly District, and was the son of Rao Bahadur M. C. S. Ananthapadmanabha Rau who retired as Principal, Government College, Kumbakonam. After a brilliant academic career in the Presidency College under Prof. W. Erlam Smith, Govinda Rau joined the Indian Institute of Science as a research student. Later, he worked under Prof. Donnan of the University College, London, for his Ph.D. Degree. On his return from the United Kingdom, he joined the staff of the Indian Institute of Science and worked there first under Prof. H. E. Watson and later under Sir C. V. Raman.

In 1940, he organised the Department of Chemical Engineering which was started at the Institute, and was in charge of it for four years. When the Alagappa Chettiar College of Technology was started by the Madras University in 1944, he was first appointed as Reader in Chemical Engineering and later made Professor and Director. During the ten years of his stewardship he was responsible for building up the A. C. College of Technology to its present position. Though ailing for some time, he took an enthusiastic interest in the furtherance of the activities and technological development of the various sections of the College.

Dr. Govinda Rau was Vice-President of the Indian Institute of Chemical Engineers, Fellow of the Indian Academy of Sciences, President of the Faculty of Technology, Chairman, Board of Studies in Technology, and a member of various academic bodies. Nearly 60 original papers have been published by him relating to dielectric constants, dipole moments, ultrasonics, and various topics in chemical engineering. He was associated with *Current Science* from its very inception and was the Secretary of the Association for many years.

His contributions to physical chemistry, and the A. C. College which he helped to shape are perhaps the fittest memorial to his life and work.

K. N. MENON.

# CORDIERITES FROM THE BURNT ROCKS OF THE JHARIA
## AND RANIGANJ COALFIELDS

### P. R. JAGAPATHY NAIDU

*Dept. of Geology and Geophysics, University of Madras*

VENKATESH[1] has described stellate twinning in cordierites from the Bokaro Coalfield. With the kind courtesy of Prof. N. L. Sharma and Dr. M. S. Sadasiviah of the Indian School of Mines, Dhanbad, cordierites from burnt rocks of the Jharia and Raniganj Coalfields were examined. The optic axial angles of cordierites, and the twin laws, vary from rock to rock. These are summarized below. The optical characters were determined on a Leitz Panphot microscope with a 4-axes stage, 1·557 segments and U.M. 4 objective. To save space, diagrams given by Rosenbusch-Mügge[3] for the various twin types, are referred to:

*Type 1.*—The grains found in vitrophyres and hornfelses of Laikdih seam, Ramnagar, Rani-

the directions of the optical ellipsoid, the extinction is prolonged. The carbon inclusions are arranged as basal plates or plugs in the direction of the C-axis, and also along the concentric lamellæ. Sometimes, both basal and prismatic sections show complex patterns of extinction (Photo 1).

*Type 2.*—The grains found in the same rocks as above, are of the size-prismatic ·1 mm. to ·24 mm. × ·16 mm. to ·08 mm. and basal, diameter ·2 mm. to ·16 mm.,—and show six or twelve sectors. There are again lamellæ parallel to the bounding faces. In grains with six sectors, the bounding faces are (110), and they are twinned on the (130) law. The scheme of extinction is after Fig. 51-*b*, p. 375, Rosen-
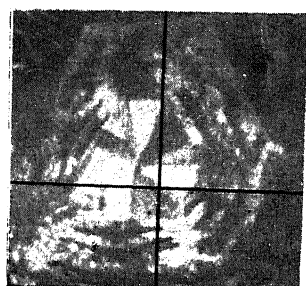


1
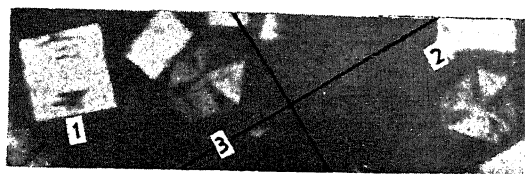


2



3
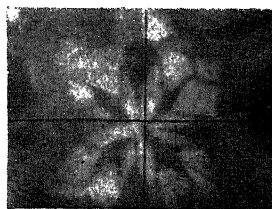


4
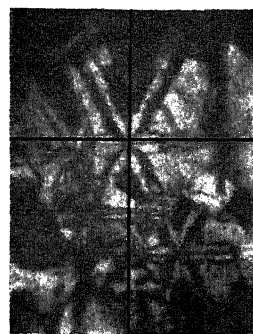


5

PHOTOS 1-5

ganj, are of the average size—prismatic 2 mm. to 1 mm. × ·4 mm. to ·3 mm., and basal, diameter ·2 mm. to ·4 mm. and show six sectors. The basal sections have pseudo-hexagonal crystal boundaries, and there are minute lamellæ parallel to these faces, but the sectors extinguish together, and the grains are either uniaxial or biaxial with a small optic axial angle (possibly below 20°), since, in one of

busch-Mügge,[3] such that two opposite sectors are extinguished, inclined to the plane of the polarizer (Grain 2, photo 2). In grains with twelve sectors, the bounding faces are (010), and the twinning is after the complex (110), (130). The scheme of extinction is after Fig. 50, p. 375, Rosenbusch-Mügge,[3] such that four sectors, forming a four-rayed figure, appear symmetrically extinguished on either side

of the plane of the polarizer (Grain 3, photo 2). The result is that there are three diametrical planes indicating the composition faces (110), and three twin planes (130) perpendicular to these. The twin planes are not sharply located by a tilt on the Fedorow stage, whereas the composition faces give sharp intersections. The prismatic sections show carbon inclusions, arranged in plates parallel to the base, and show the Andreas cross (Fig. 1, and Grain 1, photo 2). The optic-axial angles range from
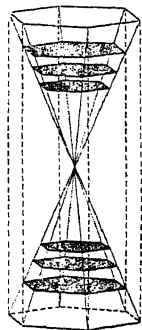


FIG. 1

— $2v = 23\text{-}46°$. The angles are variable in different sectors of the same grain.

*Type 3.*—The grains found in vitrophyres and hornfelses of the Vth seam, Jharia, are of the size-prismatic ·32 mm. to ·2 mm. × ·2 mm. to ·02 mm., and basal, diameter ·16 mm. to ·08 mm. The basal sections are always circular and do not show bounding faces. Many of these grains are corroded and the twinning lamellæ are partially destroyed. The prismatic sections show complexly intersecting lamellæ, and the carbon inclusions are arranged along these lamellæ. The twinning is of two major complex patterns. One of these is probably of the type photographed by Venkatesh.[1] This type (Fig. 2 and photo 3) is distinguished by a
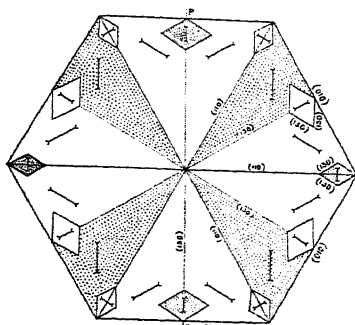


FIG. 2

central twelve-rayed star, twinned on the

complex (110), (130), and the periphery is bounded by spots, more or less four-sided in outline, six of them large, and six small. The large spots have their obtuse apices pointing towards the centre, whereas the smaller ones have their acute apices so pointing. They consist of two hexlings, turned through 60° and interpenetrated. The spots are twinned on the (110) law, after the pattern, Fig. 49, p. 375, Rosenbusch-Mügge,[3] such that two of them opposite each other extinguish symmetrically, on either side of the plane of the polarizer. A modification of this pattern has all the twelve spots with their acute apices turned towards the centre (Fig. 3, photo 4). This type con-
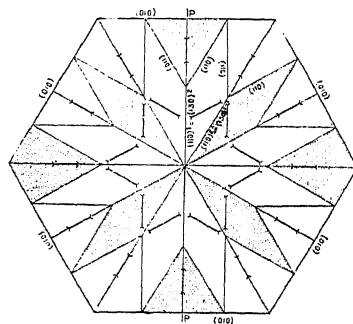


FIG. 3

sists of two hexlings twinned on the (110) law, turned through 30° and interpenetrated. The other complex pattern (Fig. 4 and photo 5)
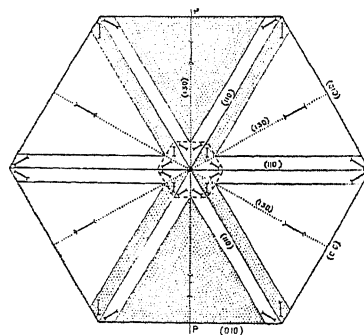


FIG. 4

has again a small twelve-rayed central core, twinned on the complex (110) (130), from which twelve lamellæ radiate to the periphery, twinned parallel to (110). The periphery is bounded by six sectors twinned on the (110) law. The optic axial angles measured on the sectors and spots of all these complex patterns range from — $2v = 69\text{-}72°$.

There was not much variation between the refractive indices measured on the grains of the above types. The range of refractive indices are $\alpha = 1\cdot530\text{-}1\cdot541$, $\beta = 1\cdot538\text{-}1\cdot543$, $\gamma = 1\cdot538\text{-}1\cdot544$. Cordierites of Type 3 ($\cdot3431$ gm.) was partially analysed with the result, $SiO_2 = 55\cdot16$, $R_2O_3 = 42\cdot20$, $CaO = 0\cdot23$, $MgO = 1\cdot49$, $H_2O - = 0\cdot11$, $H_2O + = 0\cdot38$, Total $= 99\cdot57$.

The evidence from these complex patterns seems to be that at high temperatures, the nucleus twins on the complex law, and, as the temperature falls, the periphery twins on the simple (110) law. Venkatesh[2] has made an extensive study of cordierites from India and has established this relation of the twin laws to temperature.

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## WAVE MOTION AND VIBRATION THEORY*

THE addresses given at the fifth symposium in Applied Mathematics of the American Mathematical Society held at Carnegie Institute of Technology in 1952 have been published in book form and include some of the latest advances made in the field of wave motion and vibration theory. The first four symposia dealt with non-linear problems in mechanics of continua, electromagnetic theory, elasticity and fluid mechanics.

The first three papers by C. C. Lin, S. Chandrasekhar, P. R. Garabedian discuss stability of fluid motion. C. C. Lin gives an exhaustive treatment of plane flows. The exact solutions for Poiseuille and plane Couette flows show the absence of instability. For Couette flow G. I. Taylor's result is classical. For plane Poiseuille flow contradictory results have been obtained by different workers. Lin analyses them critically and shows that the critical Reynold's number is 5,300. This is confirmed by L. H. Thomas with the help of an automatic computation machine. He also discusses the complications arising in the limiting process.

Thermal instability in plane flow sets in when the Reynold's Number (R) exceeds the value $657\cdot51$, $1,100\cdot6$, $1,707\cdot8$, according as the bounding surfaces are both free, one rigid, or both rigid. Rotational instability sets in when the Taylor's number (T) exceeds the critical value $1,707\cdot8$. S. Chandrasekhar, who has done pioneering work in magneto-hydrodynamics, finds, by using a suitable variational principle, the critical values of R and T in the presence of a magnetic field. It is found that the Reynold's and Taylor's numbers do not agree for rigid boundaries as is the case in the absence of the magnetic field.

The third paper contains the work of P. R. Garabedian, H. Lewy and M. Schiffer on axisymmetric cavitational flows which arise out of modern projectiles moving rapidly through water. Variational methods are used to calculate the shape of the cavity.

The problem of a plane shock of finite strength in a non-viscous compressible flow striking symmetrically a wedge of finite angle is mathematically untractable. John von Neumann's local three shock theory has encountered a number of difficulties. W. Bleakney discusses these difficulties in explaining the Mach reflection at a finite angle.

N. W. Mclachlan discusses the solution of a non-linear differential equation which arises in connection with a hydroelectric power system. He employs the approximate method of slowly varying amplitude and phase and obtains a number of numerical results. S. Lefschetz has discussed a generalization of van der Pol's equation.

If $\lambda$ is the square of the angular frequency of a given normal mode and $v$ the potential energy. R. J. Duffin and A. Schild show that $\delta\lambda = \delta v$. This formula can be used to find the small increase in frequency due to a small increase of constraints. It is found that there can be cases in which a nodal line may exist in the gravest mode—a question first raised by A. Weinstein. R. J. Duffin and D. H. Shaffer have given two such examples. One is that of a clamped long rectangle overlapping a circle of suitable radius and the other of a concentric doubly connected region with a sufficiently small inner circle. In acoustics, if a wall separating two rooms has a small hole in it, one of the new frequencies is much lower than all the original frequencies.

J. J. Stoker makes out that the radiation or Sommerfeld condition is not sufficient for the unique solution of the radiation problem, as it precludes the possibility of incoming wave generated at infinity. He suggests that the unnatural steady state problem be approached as a limiting case of an initial value problem.

E. H. Lee discusses wave propagation in helical springs by taking the possibility of impact into consideration. A number of results deduced by him can be readily obtained if B. R. Seth's tension-stretch law, $T = \frac{1}{2} E[1 - (1+s)^{-2}]$, for finite deformation is used. It can be used both for extension and for contraction.

The remaining six papers deal with the solution of the wave equations under different boundary conditions with the help of Fourier or Wiener-Hopf integral representations. H. Levine improves on the method of L. V. King to calculate the radiation pressure on a plane circular rigid disc in the form of a single integral equation in place of a pair of dual integral equations. W. Magus shows that the determination of transmission coefficients for the diffraction of a plane scalar (acoustical) wave by a circular aperture in a plane infinite screen leads to infinite matrices. Albert E. Heins and H. Fersbach show that the incidence of a plane wave upon two semi-infinite half planes of different admittance joined along an infinite line gives rise to integral equations of the Wienor-Hopf type. G. F. Carrier and W. H. Munk develop the diffusion theory of tides into permeable rocks to explain the cor-respondence of the frequency of water level fluctuations in Hawaiian wells to those of the ocean tide. These results agree fairly well with the small observations available. A. Weinstein gives a complete solution of the Euler-Poisson-Darboux equation

$$\nabla^2 u^k = u_{tt}{}^k + k t^{-1} u_t{}^k,$$

where

$$\nabla^2 = \sum_{i=1}^{m} \partial^2 / \partial x_i^2.$$

For $k = 0$, it reduces to the ordinary wave equation. He uses the recursion identities

$$u_t{}^k(x,t) = t\, u^{k+2}(x,t),$$
$$u^k(x,t) = t^{1-k}\, u^{2-k}(x,t),$$

and a generalisation of Hadamard's method of descent. For the Darboux operator

$$L_a u = \triangle^2 u - u_{tt} - (a/t)u_t,$$

these identities give

$$L_{\beta+2n}\, L_{a_n}\, L_{a_{n-1}} \dots L_{a_2}\, L_{a_1}\, u^\beta = 0.$$

The general solution is made to depend on the formula

$$u^k = t^{1-k} \left( \frac{\partial}{t \partial t} \right)^n (t^{k+2n-1} u^{k+2n}),$$

where $n$ is a positive integer such that

$$k + 2n \geqslant m - 1.$$

E. W. Montroll and J. M. Greenberg use the transform method to improve upon the earlier results on scattering of waves by soft obstacles.

The book can be warmly recommended to all mathematicians, physicists and engineers interested in vibration theory.

Indian Inst. of Technology,      B. R SETH.
Kharagpur.

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## RICE RESEARCH IN INDIA*

RICE, the most important food crop in India, occupies on an average 70 million acres. Research work on the crop has been going on for the past three decades and it is but fitting that the compilation of the voluminous, accumulated literature has been undertaken by the outstanding worker in the field, Shri K. Ramiah.

The monograph is divided into three parts. The very readable seven chapters under Part I are devoted to the general botany and taxonomy of the crop, its origin and antiquity and general breeding technique. Statistical figures on the acreage, production and yield of grain in different countries show that, while India has the largest acreage and second highest produc-tion, the yield per acre is low as compared to China, Japan, Formosa, Italy, Spain, etc. This problem of low yield in India has been discused in Chapter XX. In spite of three decades' work on the crop and the production of innumerable 'improved' strains at the various Research Stations (listed in *Appendix I*), only a fraction of the area seems to be under improved varieties.

The publication is a pointer to the fact that the low acre yields are not due to 'lack of experimental research or scientific knowledge'. To quote the authors, "the most significant reason appears to be the wide gap between research and extension". This is not only true for rice but for other crops as well. The present vigorous drive by the Central and State Governments for the propogation of the Japanese method of cultivation and carrying it to the

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doors of the cultivator through special staff appointed for the purpose, will, it is hoped, result in increased yields and lessening this gap between the research worker and the cultivator. The limitations in India for mechanised cultivation as adopted in many rice-growing countries is emphasised.

The collection and study of wild rices with a view to their utilisation in breeding has also been correctly emphasised. Similar collections in crops like wheat, potato and sugarcane have helped the breeder in his work of accumulation of wide and useful genetic stocks. The Central Rice Research Institute at Cuttack has recently launched a scheme for the collection of wild rices from the Jeypore tract.

The application of the breeding principles of introduction, selection and hybridisation has been dealt with in detail in Part II of the publication. The work done at the different research stations in India (before separation of Burma and Pakistan), numbering over thirty has been reviewed. The four chapters of this part call for little comment except that of recommendation to the worker in the line. It is clear that each State has its own problems in view of the varying soil and climatic conditions, and the way these problems are tried to be tackled makes informative reading.

The third part, *viz.*, genetics of rice, is essentially meant for the technical plant breeder. The two Chapters XIII and XIV dealing with the inheritance of characters are of importance in that they give an idea of the application of plant breeding and genetical methods to the production of varieties suited to varying needs. In this work the authors have their own share of contribution. The wealth of information available on this subject of mode of inheritance of morphological, physiological and quantitative characters, a knowledge of which is so essential for successful breeding, is brought out by the numerous references to the work of research workers. Detailed information on more than one hundred characters pertaining to those of stem, leaf, panicle, grain, etc., forms the subject-matter of the two chapters.

The need for the improvement of quality of rice, which is one of the practical problems connected with improvement of rice, is stressed in Chapter XIX. The external appearance of grain and its nutritive value do not seem to go hand in hand. Nutritively superior varieties are coloured and coarse and are not preferred by consumers. Attempts have to be made to evolve varieties satisfactory from the point of both external appearance and nutritive value.

Reference to nearly 500 publications is indicative of the wide coverage of the book and its monographic status.

With the wealth of information contained in the monograph, it looks like cavilling to point out a few minor defects. In view of the considerable time lag between the writing up of the main information and the printing of the monograph, the older terminology of 'Province' for 'State' persists. Plates I and II are not in their proper places. The other plates and figures could have been conveniently arranged on one side of the monograph which would have facilitated the reader. Besides the errata given at the end, there are still quite a few. The get-up of the book could have been better.

A short review of this kind cannot do full justice to the fund of information contained in the publication. There can be no doubt that this is a work which will be useful to specialists in the line as well as plant breeders, cytogeneticists and botanists in general.

Sugarcane Breeding Inst.,        N. L. DUTT.
Coimbatore.

## RADIATION GENETICS

ACCORDING to Dr. W. Ralph Singleton, Brookhaven National Laboratory in Upton, N.Y., radiation genetics—the development of new varieties of plants by the use of radiation—will soon become one of the most important events in the history of agriculture.

With the advent of atomic energy, many sources of radiation are more readily available and it has been possible to define accurately the way in which the radiations should be given, the biological conditions which must be fulfilled and the kind of radiations to use. Such studies have shown that the old concept that all radiation induced mutations are deleterious to the plant is not correct. Evidence on hand shows that some radiation induced mutations are desirable changes. New disease-resistant varieties of plants, and higher yielding types of plants have been produced in a short time and with limited expense. Success in these preliminary experiments seems to justify the use of radiation genetics on a much wider scale in plant and animal improvement.

# LETTERS TO THE EDITOR

## ON THE MASSES OF MESONS AND HYPERONS

IN a previous publication[1] the author has proposed the following empirical rule for the masses of heavy particles :

$$M_n \simeq n\bar{M} \qquad (1)$$

where $M_n$ = the rest mass of the particle designated by the integral quantum number $n$,
$\bar{M} = m/2\,a = \hbar/2\,ac$ = the mass quantum for heavy particles, where $m$ = the electron mass, $a = e^2/\hbar c$ = the fine structure constant, $a = e^2/mc^2$ = the classical electron radius. On the basis of the above rule, quantum numbers have been assigned to various particles. These quantum numbers are found to possess the statistical property by virtue of which the even quantum numbers refer to

Bosons while the odd quantum numbers refer to Fermions.

Since more accurate measurements of some meson masses are now available, a fresh comparison of the calculated and the experimental masses is tabulated below with all masses expressed in the electron mass units :

| Particle | Quantum number | Mass (calculated) | Mass (observed) |
|---|---|---|---|
| $\mu\pm$ .. | 3 | 206 | 207 ± 1[2] |
| $\pi\pm$ .. | 4 | 274 | 273 ± 1[2] |
| $\tau\pm$ .. | 14 | 959 | 966 ± 2[3] |

It is clear that the agreement between the calculated and the experimental masses is now much closer than before.

When the above rule was first proposed it was pointed out that it would be inconsistent to include the stable nucleon as a member of a set of such unstable particles as mesons and hyperons. Further the hyperon $\Lambda^0$ (formerly called $V_1^\circ$) was assigned the even quantum number $n = 32$ even though it is a Fermion by virtue of its decay scheme $\Lambda^0 \to P + \pi^-$. This situation is now aggravated by the discovery of the hyperon $Y^-$ which has to be assigned the even quantum number $n = 38$ although it is a Fermion because of its decay scheme $Y^- \to \Lambda^0 + \pi^-$. Thus the statistical properties of the quantum numbers for the mesons and the hyperons appear to be opposite.

The above difficulties can be removed if one assumes that the nucleon is not a member of any such set and that the hyperons form a new set based on the nucleon just as the mesons form a set based upon the leptons. Thus one may propose a more general empirical rule as follows:

$$\mathbf{M}_n = \mathbf{M}_0 + n\overline{\mathbf{M}} \qquad (2)$$

where $\mathbf{M}_0 =$ the mass of the basic particle. It is clear that for the mesons $\mathbf{M}_0 \simeq 0$ and the new rule reduces to the previous rule, while for the hyperons $\mathbf{M}_0 \simeq 1837$. A comparison of the calculated and the experimental masses for the hyperons is tabulated below with all masses expressed in the electron mass units:

| Particle | Quantum number | Mass (calculated) | Mass (observed) |
|----------|----------------|-------------------|-----------------|
| $\Lambda^\circ$ | 5 | 2180 | $2181 \pm 1$[4] |
| $Y^-$ | 11 | 2591 | $2586 \pm 12$[5] |

It is clear that the above quantum numbers for the hyperons now possess the same statistical property as that possessed by the meson quantum numbers.

It will be interesting to observe whether further mass measurements would be consistent with the proposed empirical rule.

M. G. Science Institute,    K. M. GATHA.
Navarangpura, Ahmedabad-9,
*August* 5, 1954.

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# DECAY OF PHOSPHORESCENCE OF LONG DURATION IN MAGNESIUM OXIDE

MAGNESIUM OXIDE when bombarded by cathode rays shows both fluorescence and phosphorescence. The fluorescence spectrum of a fresh specimen[1] shows two bands one of which is strong and broad having the peak at 4400-4550 Å (2·75 ev.) and the other is weak with peak at 5750 Å (2·16 ev.). The phosphorescence is mainly associated with the former band and
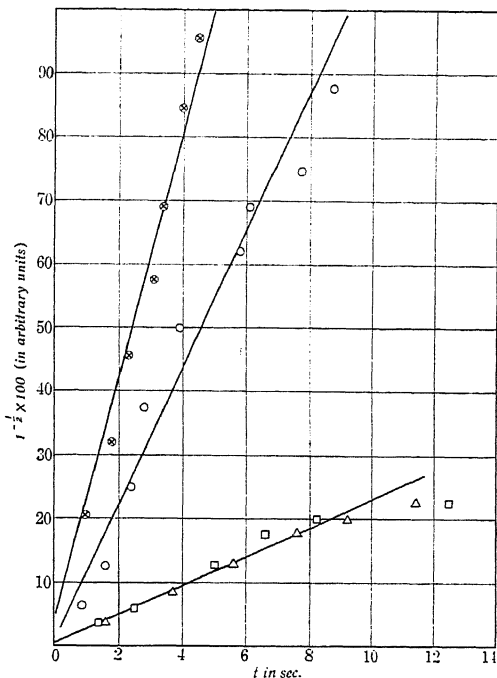


FIG. 1

$\otimes$    Crystal Exposed to cathode rays for 20 hours
$\bigcirc$    Fresh untreated crystal.
$\triangle$    Crystal heated bunsen flame for 5 hours.
$\square$    Crystal heated in oxygen coal gas flame for 3 min.

appears to be of long duration. We have studied the decay of phosphorescence in several samples, namely, (1) a fresh untreated specimen, (2) a sample having 20 hr. previous exchange to cathode rays, (3) a fresh sample heated in bunsen flame for 5 hr. and (4) a fresh sample heated in oxygen coal gas flame for 3 minutes. All the samples were clear cleavage pieces from a single crystal of MgO obtained from the National Research Council of Canada at Ottawa.

The arrangement for studying the decay of phosphorescence was as follows. The crystal was first excited to luminescence by turning on the cathode rays momentarily using the cathode

ray tube described previously.[2] The decay was then observed with the help of a Lummer Brodhun photometer and the time required for the phosphorescence to decay to fixed levels of intensity was determined, correct to 0·1 second. Each observation was repeated at least 20 times. The mean error in any single observation is about 10 per cent.

As is well known the phosphorescence of long duration may be ascribed to the re-combination of the trapped electrons with holes in luminescent centres, the electrons being excited into the conduction band thermally. For the decay of this type of luminescence, Mott and Gurney[3] derive a relation

$$I^{-\frac{1}{2}} = I_0^{-\frac{1}{2}} (1 + A \, n_0 t) \qquad (1)$$

where

$$I_0 = A \, n_0^2 \qquad (2)$$

In these, $n_0$ is the number of electrons per unit volume in the conduction band including the traps at time $t = 0$ and A is a constant giving the probability of radiating on capture, and I is the intensity of emitted radiation. For long after-glows the electrons come entirely from the traps and the sooner the electrons leave the traps the larger will be the value of A. If $I^{-\frac{1}{2}}$ in equation (1) is plotted against $t$, the curve obtained is a straight line, whose slope is $A^{\frac{1}{2}}$ and the intercept on the I-axis gives $I_0$ (the intensity at time $t = 0$). If, however, we plot $I_0^{\frac{1}{2}}/I^{\frac{1}{2}}$ against $t$ we get a straight line whose slope is $An_0$. This gives the decay period $t = 1/An_0$, i.e., the time in which the intensity is reduced to one-fourth of its original value.

The curves are shown in Fig. 1. Relation (1) appears to be satisfied though the observations have a restricted time range. From the curves the values of $I_0^{-\frac{1}{2}}, A^{\frac{1}{2}}$, $n_0$ and $An$ are obtained as given in Table I.

TABLE I

| Specimen | $I_0^{-\frac{1}{2}}$† | $A^{\frac{1}{2}}$ | $n_0$‡ | $An_0$ |
|---|---|---|---|---|
| 20 hr. previous exposure to cathode rays | $\dfrac{1}{20}$ | $\dfrac{1}{5}$ | 100 | 4 |
| *Fresh untreated specimen | $\dfrac{1}{40}$ | $\dfrac{1}{10}$ | 400 | 4 |
| Heated specimens | $\dfrac{1}{200}$ | $\dfrac{1}{50}$ | 10,000 | 4 |

* The scatter of points about the line is rather large in this case, and therefore the figures given may be slightly in error ; † The value of $I_0$ has been obtained by extrapolation, and is in arbitrary units ; ‡ The valves have only relative significance.

It is interesting to note that the decay curves for different specimens show widely divergent slopes. But the decay period is almost the same for all of them and of the order of 0·25 second. We see further that the number of electrons in the conduction band is relatively smaller for the specimen having large previous exposure to cathode rays, than for heated specimens. This may also be inferred directly. In the former case the phosphorescence becomes too feeble to be perceived by the eye in five seconds, though it continues for 17 seconds in heated specimens. Since the decay period is the same for both it follows that the former must have a smaller value of $I_0$ and therefore of $n_0$.

The theory supposes that every electron in the conduction band gives rise to luminescence. It is, however, possible that the impurity centre is such that there are both populated and vacant levels in the region between the conduction and the valence band of the crystal and the vacant levels lie between the conduction band and the populated levels. Cathode ray excitation creates holes in the populated levels and in the valence band, but some of the electrons from the conduction band will be captured by the vacant levels and will be unable to produce luminescence by combining with holes in the populated levels. Thus the effective number of electrons producing luminescence can be much smaller than the actual number. It is possible that the impurity centres created by cathode ray excitation (these are possibly metal-ion-excess centres) have such levels. Weber[4] finds that MgO heated in Mg vapour has absorption bands at 2·35, 3·6 and 4·93 electron volts and photoconductivity experiments of Day[5] show that the 3·6 ev. levels are empty and their number is much larger than that of the populated 2·35 ev. levels. The large value of $n_0$ in heated specimens may be due to the presence of some populated impurity level very close to the conduction band.

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# THE NUCLEAR POTENTIAL WELL FOR HIGH ENERGY NUCLEON SCATTERING

To correlate the experimental data on the nuclear scattering of 90 Mev. neutrons, Fernbach, Serber and Taylor[1] have introduced the optical model of the nucleus. In this model a nucleus is represented by a sphere with a uniform distribution of nuclear matter characterised by a complex refractive index for the nucleon wave given by

$$n = 1 + k_1/k + i(K/2k) \qquad (1)$$

The real parameter $k_1$ is obtained by assuming a real potential well from the expression

$$(k_1/k) = [\{(E+V)^2 - \mu^2 c^4\}/\{E^2 - \mu^2 c^4\}]^{\frac{1}{2}} - 1 \qquad (2)$$

where V = the depth of the potential well while the other parameters have their usual meanings.

However, there is also another expression[2] for this parameter given by

$$(k_1/k) = (\pi\rho/k^2)\{f_{nn}(0) + f_{np}(0)\} \qquad (3)$$

where $f_{nn}(0)$ and $f_{np}(0)$ are the forward scattering amplitudes for $(n, n)$ and $(n, p)$ scattering respectively, and $\rho$ is the nucleon density. Since the nucleon-nucleon scattering experiments do not provide these forward scattering amplitudes unambiguously one obtains them by assuming some models for the nucleon-nucleon interaction. We have obtained from Jastrow[3] the plots of $k_1$ against energy for the tensor interaction model of Christian and Hart[4] and Christian and Noyes[5] as well as for the hard core nucleon model of Jastrow[6] for the nuclear radius given by $R = 1.38 \times 10^{-13} \times A^{\frac{1}{3}}$ cm.

We have obtained the depth of the potential well by equating graphically the parameter $k_1$ for an energy E obtained from equation (2) with the parameter $k_1$ at $(E + V)$ Mev. obtained from equation (3) for the above models for the nucleon-nucleon interaction. We find that the potential decreases practically linearly from $V = 29$ Mev. to $V = 22$ Mev. for the tensor interaction models and from $V = 17$ Mev. to $V = 10$ Mev. for the hard core model respectively when the energy varies from $E = 90$ Mev. to $E = 320$ Mev.

Fernbach, Serber and Taylor[1] had assumed $V = 30$ Mev. to explain the experimental data on the nuclear scattering of 90 Mev. neutrons. It can be seen that the tensor interaction models give $V = 29$ Mev. while the hard core models give $V = 17$ Mev. Thus the previously assumed potential well agrees with the potential given by the former model in the case of a uniform nuclear density distribution.

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# ON AN ABNORMAL TYPE OF TRYBLIOLEPIDINE-NUCLEOCONCH FROM AUSTRALIA

VARIOUS horizons of *Lepidocyclina*-bearing beds have been reported from the Australian Tertiaries. Of these the subgenus *Trybliolepidina* has been reported only from Victoria, and is restricted to the Tertiary-'f' stage in the Indo-Pacific region. These have been studied in detail by Miss Irene Crespin.[1] Recently the present author along with Sah, D. L., Mohan, K. and Rao, V. V.,[2] reported the occurrence of *Trybliolepidina* from India, in the Lower Miocene (Upper Burdigalian) beds of Kathiawar.* The Australian species of *Trybliolepidina* described by Crespin are : *Lepidocyclina* (*Trybliolepidina*) *batesfordensis*, *L.* (*T.*) *howchini*, and *L.* (*T.*) *gippslandica*. The Indian species are different from the Australian species.

The material for the present study was kindly lent by Miss Crespin and consists of several specimens of the two species : *L.* (*T.*) *batesfordensis* and *L.* (*T.*) *howchini*. Several oriented sections were prepared of these specimens, and only one section of *L.* (*T.*) *batesfordensis* shows the abnormal type of nucleoconch described below.

The nucleoconch of a typical *Trybliolepidina* consist of two chambers, the smaller one called the protoconch which is surrounded on three sides by the larger chamber called the deuteroconch. The nucleoconch generally has a thick wall and is surrounded by six to eight nepionic chambers. The equatorial chambers are ogival to spatulate in shape.

In the present specimen, the nucleoconch, instead of having two normal chambers, consists of three chambers. Here the normal proto-

* Previously, this was recorded as Vindobonian. This is now being considered as Upper Burdigalian in view of the recent work done in this Department.

conch has been replaced by two chambers, which are partially surrounded by a third one, which is the normal deuteroconch. These three chambers are enclosed within a thick wall and are then surrounded by eight nepionic chambers, two principal auxiliary and six ad-auxiliary chambers.
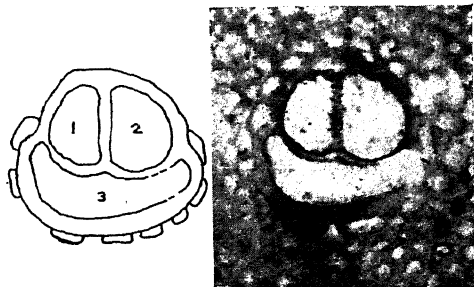


FIG. 1. *Lepidocyclina (Trybliolepidina) batesfordensis* showing abnormal type of nucleoconch, × 45.

It is quite obvious that some type of protoconchal division has taken place here giving rise to this abnormal type of nucleoconch. Crespin (personal communication) did not notice such a striking case of abnormality in this species.

### Measurements of the nucleoconch

| | | |
|---|---|---|
| Diameter of the first chamber | ·· | 124·7 $\mu$ |
| do.     second chamber | ·· | 154·8 $\mu$ |
| do.     third chamber | ·· | 417·1 $\mu$ |
| Width of the first chamber | ·· | 189·2 $\mu$ |
| do.     second chamber | ·· | 202·1 $\mu$ |
| do.     third chamber | ·· | 116·1 $\mu$ |
| Thickness of the partition-wall between chambers 1 and 2 | ·· | 21·5 $\mu$ |
| Thickness of the partition-wall between chambers 1 and 3 | ·· | 17·2 $\mu$ |
| Thickness of the partition-wall between chambers 2 and 3 | ·· | 17·2 $\mu$ |
| Thickness of the outer-wall | ·· | 38·7 $\mu$ |

The equatorial layer is polygonal with seven rays extending almost to the margin of the test. The equatorial chambers are ogival near the nucleoconch but becomes spatulate near the periphery. In the rayed portion the chambers are spatulate to hexagonal in shape.

Cushman[3] has also noted some forms of abnormalities in Orbitoididæ. He stated : "Abnormality of the initial chambers is of rather common occurrence in some genera of the Orbitoididæ. It is the multiplication of the initial chambers which produces the phenomenon designated 'gigantisme' by H. Douville".

The author is grateful to Miss Irene Crespin, not only for the loan of the above material, but also for the valued opinion and kind per-

mission to publish this note. Grateful thanks are also due to Prof. S. R. Narayana Rao for guidance and encouragement.

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## PYROPHOSPHATE COMPLEXES OF NICKEL AND COBALT

In a previous communication the work on pyrophosphate complexes of tin and zinc was briefly reported.[1] The present investigation deals with a study of similar complex formation with nickel and cobalt at room temperature by potentiometric, conductometric and spectrophotometric methods. The effect of dilution has also been studied, the dilution range being 1 to 50, for potentiometric and conductometric, and 1 to 10 for spectrophotometric studies. The Marconi glass electrode was used for potentiometric, the Kohlrausch bridge for the conductometric and Coleman Model 14 universal instrument (visible region) with 4 cm. cell for spectrophotometric studies.

From the pH conductivity curves the ratio of $P_2O_7$: metal in the complex has been found to be 1 : 1 as well as 2 : 1 for both the metals, i.e., $[Ni(P_2O_7)]^{-2}$, $[Ni(P_2O_7)_2]^{-6}$ **and** $[Co(P_2O_7)]^{-2}$, $[Co(P_2O_7)_2]^{-6}$ (complex). Haldar[2] has similarly reported the existence of these complexes in both the ratios, whereas Rogers and Reynolds[3] mention only 1 : 1 ratio.

Job's[4] method of continued variation was employed for spectrophotometric measurements and the complex was found to correspond to 1 : 1 ratio. The maximum absorption regions for nickel and cobalt complexes were found at 550 and 425 m$\mu$ respectively. The instability constant K of both these complexes has been calculated according to the method of Harvey[5] and found to be of the order of $10^{-4}$ for both the metals. James and Arnold[6] also have reported a value of the same order for the copper pyrophosphate complex (1 : 1) by the spectrophotometric method.

The behaviour of these complexes in electroplating baths is being investigated.

Our thanks are due to Prof. K. R. Krishnaswami for his keen interest in the investigation. One of the authors (J. V.) is grateful to

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## THE CALCULATED THERMODYNAMIC PROPERTIES OF CARBONYL FLUORIDE

THERMODYNAMIC properties of formaldehyde, deuteroformaldehyde, phosgene, and thiophosgene are calculated by Thompson (1941[1]). In the present report the thermodynamic quantities (heat content, free energy, entropy and heat capacity) are calculated for carbonyl fluoride, which also belongs to the above series of compounds. These thermodynamic quantities are calculated for temperatures from 100° K to 1000° K to a rigid rotator harmonic oscillator approximation for the ideal gaseous state at 1 atmos. pressure. The frequencies of the fundamentals are (Nielsen *et al.*[3]).

$$v_1 = 965 \text{ cm.}^{-1}, \ v_2 = 1928 \text{ cm.}^{-1}, \ v_3 = 626 \text{ cm.}^{-1},$$
$$v_4 = 1248 \text{ cm.}^{-1}, \ v_5 = 584 \text{ cm.}^{-1}, \ v_6 = 774 \text{ cm.}^{-1}$$

The moments of inertia are (Nielsen[2])

$$I_A = 69 \cdot 98 \times 10^{-10} \text{ gm. cm}^2, \ I_B = 71 \cdot 70 \times 10^{-10} \text{ gm. cm}^2$$
$$I_C = 141 \cdot 68 \times 10^{-10} \text{ gm.cm}^2$$

The calculations are summarised in the following table.

TABLE I

*Heat content, free energy, entropy and heat capacity of carbonyl fluoride in gaseous state at 1 atm. (calories per mole/° C.)*

| T(°K) | $(H^\circ - E_o^\circ)/T$ | $-(F^\circ - E_o^\circ)/T$ | $S^\circ$ | $C_p^\circ$ |
|---|---|---|---|---|
| 100 | 7·95 | 43·95 | 51·91 | 8·00 |
| 200 | 8·23 | 49·50 | 57·73 | 9·29 |
| 300 | 8·92 | 52·98 | 61·91 | 11·32 |
| 400 | 9·75 | 55·66 | 65·41 | 13·08 |
| 500 | 10·56 | 57·92 | 68·48 | 14·45 |
| 600 | 11·30 | 59·90 | 71·20 | 15·50 |
| 700 | 11·96 | 61·70 | 73·66 | 16·30 |
| 800 | 12·54 | 63·36 | 75·90 | 16·92 |
| 900 | 13·05· | 64·83 | 77·89 | 17·40 |
| 1000 | 13·51 | 66·25 | 79·76 | 17·78 |

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## CRYSTALLINE COMPONENTS OF THE ROOTS OF *TEPHROSIA MAXIMA* AERS.

FROM the roots of *Tephrosia maxima* Aers. which grows abundantly in Waltair we have isolated 3 crystalline substances (I, II and III) in yields of 0·8, 1·0 and 0·8 per cent. respectively. Their salient properties are given below:
I: m.p. 227-29°, probable formula $C_{17}H_{10}O_6$, free from methoxyl; II: m.p. 126-28°, probable formula $C_{22}H_{20}O_5$ or $C_{17}H_{14}O_4$, free from methoxyl; III: m.p. 143-45°, probable formula $C_{23}H_{22}O_6$ with one methoxyl group. All the 3 substances gave a positive reaction for the presence of the methylenedioxy group as tested by the gallic-sulphuric acid reaction.[1] None of them gave a ferric colour and all of them were recovered after heating with acetic anhydride and sodium acetate at 140° for 3 hours. On hydrolysis with 12 per cent. aqueous alcoholic KOH, all of them yielded formic acid (identified by its reducing action on mercuric chloride and by its reduction to formaldehyde which again was identified by its colour reactions) and phenolic ketones indicating that they may be isoflavones. Among the products of KOH-$H_2O_2$ treatment, piperonylic acid was identified in the case of I and II.

A consideration of the properties (including toxicity to fish, not recorded here) and reactions of these compounds indicates that they may not be identical with any of the substances described earlier in the literature. They are therefore tentatively designated Maxima Substance A, Maxima Substance B and Maxima Substance C respectively. Full details will be published elsewhere.

We thank Sri. C. Rajasekhara Mudaliar, Agricultural College and Research Institute, Coimbatore, for the identification of the plant.

Dept. of Pharmacy,    S. RANGASWAMI.
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# EXCRETION OF NICOTINURIC ACID AS A METABOLITE OF NICOTINIC ACID BY RICE MOTH LARVA

In an earlier communication from this laboratory,[1] it was reported that the rice moth larva (*Corcyra cephalonica* St.) excretes exogenously supplied nicotinic acid or nicotinamide mainly as nicotinic acid and that N'-methyl nicotinamide is not the principal end product of niacin metabolism in this insect larva, unlike in many species of higher animals. We have since observed that the larva excretes, besides nicotinic acid, nicotinuric acid, which is the glycine conjugate of nicotinic acid, in smaller but significant amounts.

The excreta of rice moth larvæ maintained on an experimental diet[1] containing nicotinic acid or nicotinamide at a level of 4 mg. per 10 g. of diet were extracted with water, the extract concentrated *in vacuo* and finally taken up in 50-60 per cent. alcohol. 100 mg. of the excreta was thus worked up to yield about 0·5 ml. of the final concentrate. The concentrated extract was analysed chromatographically for niacin metabolites as described previously.[1] Nicotinuric acid was identified in the fæcal extract against an authentic sample chromatographed alongside the extract in the usual way. Further confirmation in this regard was obtained as follows :

The concentrate obtained from 200 mg. of larval excreta was placed as a series of spots on two big sheets (40 × 28 cm. each) of Whatman No. 1 filter-paper and resolved by irrigating the papers with the upper phase of a mixture of *n*-BuOH : MeOH ; Benzene : Water (2 : 1 : 1 : 1). Reference strips were cut out from the dried sheets and developed with cyanogen bromide and benzidine.[1] By reference to these strips, the portions of the two original chromatogram sheets expected to carry the metabolite suspected to be nicotinuric acid were cut out and eluted with successive portions of distilled water. The combined eluate, after concentration *in vacuo*, was hydrolysed with 5 N hydrochloric acid in a sealed tube at 100° C. for 3 hours. After removal of most of the hydrochloric acid, the hydrolysate was concentrated and finally adjusted to pH 7·0 and chromatographed as usual. A concentrate of the eluate from the chromatogram prior to hydrolysis was also run alongside. Two solvent systems, namely, *n*-BuOH : MeOH : Benzene : Water (2 : 1 : 1 : 1) and *n*-propanol : Water (60 : 40) were used. The unhydrolysed concentrate yielded the nicotinuric acid spot, but the hydrolysate showed up no spot due to this

metabolite, but exhibited spots corresponding to pure nicotinic acid and glycine. The $R_f$ values of the various substances are listed in Table I.

## TABLE I
*$R_f$ values of the various metabolites*

| Metabolite | Reaction and colour | $R_f$ value in A | B |
|---|---|---|---|
| Nicotinic acid .. | CNBr and Benzidine Pink spot | 0·80 | 0·47 |
| Nicotinamide ·· | CNBr and Benzidine Brownish pink spot | 0·89 | 0·77 |
| Nicotinuric acid | CNBr and Benzidine Light violet spot | 0·74 | 0·34 |
| Glycine ·· | Ninhydrin–Violet spot | 0·50 | * |

A—Propanol : water, B—BuOH : MeOH : Benzene : H₂O.
* The hydrolysate of the chromatogram eluate gave a streak.

An interesting observation was the presence of nicotinuric acid in the larval excreta even when nicotinamide was ingested. This points further to a deamidating mechanism being present in the larvæ, since conjugation of nicotinamide with glycine to form nicotinuric acid has to be preceded by the conversion of nicotinamide to nicotinic acid.

Controversial reports have appeared in the literature in regard to the role of nicotinuric acid as a normal end product of niacin metabolism in mammals.[2-6] However, the latest evidence[7] based on experiments with C14-labelled nicotinic acid and nicotinamide indicates that nicotinuric acid is to be considered rather as a detoxication product of nicotinic acid formed extensively when massive, as distinct from physiological, doses of the vitamin are administered. The work of Johnson and Lin[7] as well as that of Kodicek and Reddi[8] further demonstrates that little nicotinuric acid is excreted by the rat when it is given a supplement of nicotinamide. This is in contrast to our findings, as the rice moth larva excretes the glycine conjugate even when fed nicotinamide. This fact, in conjunction with our earlier observations,[1] would indicate that the larva metabolises the vitamin somewhat differently from the rat.

Recently evidence has been accumulating[9-11] to show that CoA is involved in the enzymatic synthesis of hippuric acid from glycine and benzoic acid, and, as suggested by Chantrenne,[9] CoA might also participate in other condensation reactions involving a carboxyl group. The very recent work of Schachter and Taggart[12] on glycine-N-acylase is in conformity with such a hypothesis. In this connection the demonstra-

tion by Jones and Elliott[13] of the synthesis of nicotinuric acid *in vitro* from glycine and nicotinic acid is of interest. An investigation of the possible role of pantothenic acid in the formation of nicotinuric acid, which appears to be analogous to the biosynthesis of hippuric acid,[14] is in progress in the rice moth larva as well as in the rat and will be published in detail elsewhere.

We wish to thank Dr. E. Kodicek for the generous gift of nicotinuric acid and the Lady Tata Memorial Trust, Bombay, for the award of a research scholarship to one of us (T. K. S.).

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## SURFACE DEPENDENCE OF NON-SELF-MAINTAINED REGION OF A.C. ELECTRIC DISCHARGE IN IODINE VAPOUR

IN a previous communication,[1] it has been pointed out that over a narrow potential region corresponding to the non-self-maintained region of an a.c. electric discharge in iodine vapour, even visible light initiated the discharge; this is accompanied by the production, on otherwise smooth sinusoidal current trace, of pulses of uniform height as in the well known Geiger region of G.M. counters ope-

rated by unidirectional potentials.[2] Further, the width of the non-self-maintained region decreased markedly by continued working of the system at potentials above the threshold of the self-maintained discharge.[1] It is well known that essentially the same behaviour is noticeable in the counters, which has been attributed to the decomposition under electron impact of the polyatomic molecules like alcohol vapours, etc. In view of the absence of any such circumstance in systems containing iodine, the above appeared to be of interest. The data reported below indicate, for the first time, the marked dependence of the non-self-maintained region on the electrode surface, to be distinguished from the homogeneous gas phase.

The experimental arrangement was essentially the same as described earlier.[1] Cylindrical discharge tubes made out of soft soda glass and filled with iodine vapour were employed. They were fitted with external sleeve electrodes and excited by 50 cycle potentials; the current was investigated by a cathode-ray oscillograph and a galvanometer.[1] Fig. 1 gives a
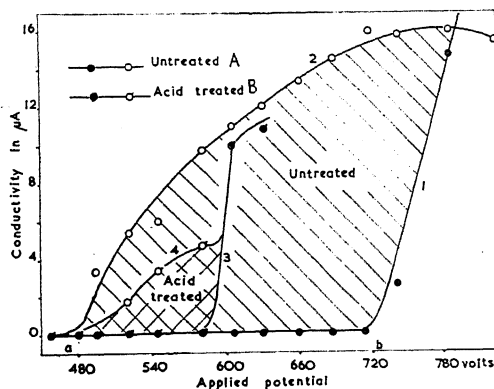
FIG. 1. Non self-maintained region of a.c. electric discharge in iodine vapour in acid-treated and untreated discharge tubes (Curves 1 and 3—in dark, 2 and 4—under light from 200 watt bulb).

typical series of results in two discharge tubes *A* and *B*; the walls of the vessel *B* were treated with chromic acid and boiling distilled water to remove surface alkali,[3] before admitting iodine vapour therein. The system *A* was not treated likewise. It was interesting to note that in the potential range *ab* (Fig. 1), the discharge in the absence of external radiation was negligible as evidenced by the very small conductivity *i* (Curve 1, Fig. 1), and non-occurrence of pulses on the oscillographic screen (Fig. 2, *a*). When the system was exposed to visible light (7800–3700 Å), a marked

increase of $i$, accompanied by the production of pulses on the current trace (Fig. 2 b), was
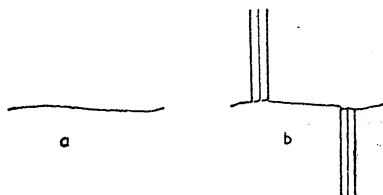


FIG. 2. Oscillograms representing the current structure in non-self-maintained a.c. electric discharge (a–in dark, b—under light from 200 watt bulb).

noticed ; these features were observed so long as the external radiation was on. Above the potential b (Fig. 1), the discharge became self-maintained.[1] It may be noted from curves (1) and (2) of Fig. 1 that at large $V$ ($> 780$ volts), the effect of irradiation is to decrease the conductivity $i$. When the radiation was cut off, the initial value of $i$ was restored immediately (Curve 1, Fig. 1). This decrease of $i$ with external light, which is reproducible beyond doubt of experimental error, cannot be anticipated from general theoretical considerations of photo- and thermo-electric effects.[7] The differential behaviour of discharge tubes $A$ and $B$ with respect to this finding, has been dealt with by Ramaiah.[8] The data in Fig. 1 further show the marked influence of acid treatment of the electrode walls on the non-self-maintained region of the discharge ; the removal of surface alkali which decreased the potential width of this region, is of marked importance (cf. Curves 1-4, Fig. 1). It is well known that ordinarily, glass surface contains water vapour adsorbed in the form of molecular or van der Waal's layers. During evacuation of the system prior to introduction of iodine, they are in part removed.[3] Existence of compounds like alkali on glass surface inhibits their removal ; this is in accord with the experiments of Faraday,[4] Warburg and Imhori,[5] and Harries and Schumacher[6] on the adsorption of water vapour on glass surface with and without alkali. This is substantiated by the observation that the removal of water vapour from glass walls by process of degassing the vessel at 200° C., also reduced the non-self-maintained region in iodine vapour. Thus, water vapour layers adsorbed on the electrode walls appeared to influence markedly the potential width of the non-self-maintained region in iodine vapour. This is in good agreement with the data obtained with various films like KCl, NaOH, KI,

etc., deposited on the walls of B, which affect appreciably the content of an der Waal's adsorption of water vapour, and therefore, the potential width of the non-self-maintained region in iodine vapour.

The details of the results and the mechanism responsible therefor, will be published elsewhere.

Dept. of Chemistry,     B. D. KHOSLA.<br>University of Delhi,     H. C. GAUR.<br>Delhi, *September* 25, 1954.     N. A. RAMAIAH.

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## DOUBLE ENTERIC INFECTION BY SALMONELLA TYPHI AND SALMONELLA PARATYPHI A.

Two main types of Salmonella infection in man may be distinguished. These are: ($a$) the slow, continued fevers of the "enteric type", *viz.*, the typhoid-*para*-typhoid fevers, and ($b$) the sudden, usually transient, stormy, gastro-intestinal disturbances of the "food poisoning" types. Of these, the "enteric group" of fevers are due to the common infections and typhoid fever has remained one of the most widespread and important of all bacterial diseases, wheras the less common *para*-typhoid infections are milder but are otherwise similar to infection with the typhoid bacillus. The only method by which typhoid and *para*-typhoid fever can be distinguished with certainty is by the isolation and identification of the causal micro-organisms.

Kayser[1] was among the first to describe a case of enteric fever in which two organisms of the enteric group (*Sal. typhi* and *Sal. paratyphi* A.) were isolated during the course of the disease. Leboeuf and Braun[2] found only one case in a series of 12,028 blood cultures. A case of *triple* enteric infection has been described by Castellani[3] in 1915. There are records of *thirty-nine* isolated cases so far in which the diagnosis of double enteric infection can be accepted (Battyshaw and Mackay[4]). (A double enteric infection is defined as the

simultaneous infection of an individual or a group of individuals, with two organisms of the enteric group).

In reviewing the literature, double enteric infection has not been reported so far in India. A case of double enteric infection is reported where the diagnosis was established bacteriologically by isolating *Sal. typhi* and *Sal. paratyphi* A., from the blood of a patient. This is considered to be of importance in the clinical, bacteriological and epidermiological studies of enteric infections.

A detailed report is under publication elsewhere.

The authors' thanks are due to Col. B. L. Taneja, for his keen interest in this investigation.

Dept. of Pathology,          H. N. DUTTA.
Armed Forces          L. D. SACHDEVA.
   Medical College,
Poona, *August* 12, 1954.

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## ON BLACK-GRUB DISEASE IN THE FRESH–WATER CARP *CATLA CATLA*

IN September 1953 a high mortality was reported among the fingerlings of the fresh-water carp *Catla catla* kept in one of the State fisheries pond at Samalkot (E. Godavari Dt.). About 100 of the fingerlings of various sizes were sent to us for examination. It was observed that many of the fingerlings showed black ovoid or irregular patches on the body surface which on closer examination proved to be the black pigment patches overlying metacercaria cysts of the digenetic trematode,
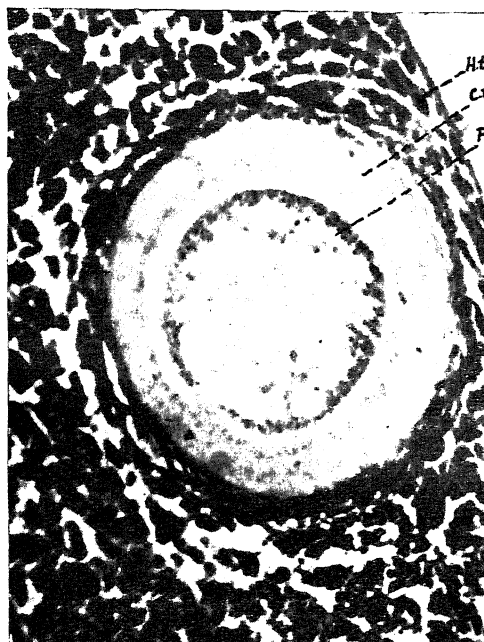


FIG. 2    Section of muscle with cyst. *c.t.*, connective tissue layer ; *H.t.*, Host tissue ; *P.*, Parasite.



FIG. 1.    Fish infected with Metacercariæ cysts (*c*).
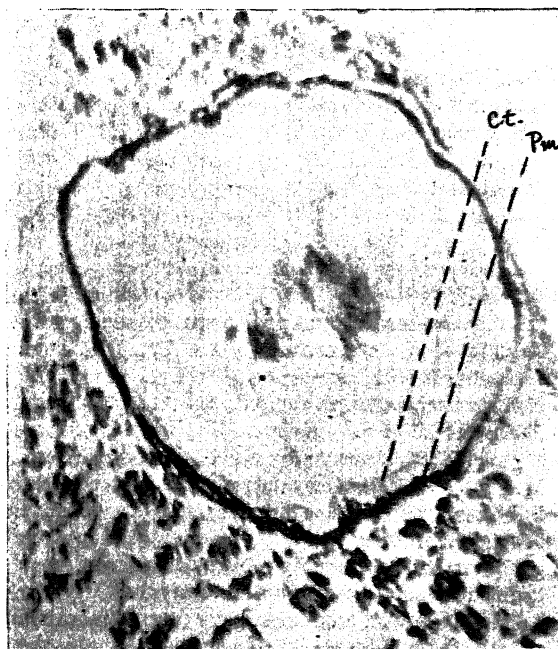


FIG. 3. Section of cyst showing pigmented zone (*Pm*)

*Diplostomum* sp. (Fig. 1). The cysts are located in the muscles just beneath the skin with a tendency to crowd at the bases of the major fins like the dorsal and the caudal, where adjoining cysts might even fuse and assume varying shapes. Normally, the cysts are oval. The cyst-wall is composed of two layers, a thick outer cellular connective tissue layer overlies a thin hyaline non-cellular layer which closely invests the parasite (Fig. 2). A pigment zone is clearly to be seen at the periphery of the connective tissue layer in most cysts (Fig. 3).

The metacercaria has distinct oral and ventral suckers, of which the latter is transversely elongated. On either side of the anterior end of the parasites there are conspicuous pseudo-suckers. The anterior region of the body is demarcated from the posterior region by a constriction. In the anterior cup-shaped region are situated the suckers as well as an adhesive organ behind the ventral sucker. The rudiments of the reproductive system are situated in the posterior region (Fig. 4). Measurements
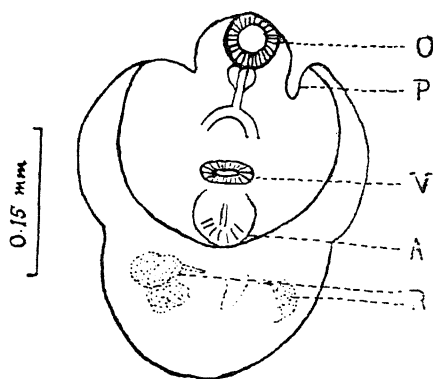


FIG. 4. Metacercaria removed from cyst.
*A*, Adhesive organ ; *O*, Oral sucker ; *P*, Pseudosucker ; *R*, Rudiments of reproductive system ; *V*, Ventral sucker.

of the various regions are given below.

| | |
|---|---|
| Length of metacercaria | 0·38 mm. |
| Breadth of anterior region | 0·32 mm. |
| Breadth of posterior region | 0·23 mm. |
| Diameter of oral sucker | 0·05 mm. |
| Diameter of adhesive organ | 0·07 mm. |

We did not find any correlation between the length of fish and the number of cysts present. Mortality rate among the infected fish appears to be high as fish under observation in aquaria tanks died one after another quickly. At the moment we are unable to say how the death of the host is caused. It may be due to the movements of the parasite within the tissues of the host as reported by Davis[2] for other

strigeid metacercaria or it may be the result of the toxins liberated by the parasites. This aspect is under investigation. Not only fish but also amphibians[2] and even snails[1] are reported to harbour the metacercaria of *Diplostomum flexicaudum*.

Patwardhan[5] and Lal[4] described the adults of a strigeid trematode *Proalaria alcedensis* from the intestine of the Kingfisher *Alcedo atthis*. The genus *Proalaria* has now been shown by Dawes[3] as a synonym of *Diplostomum*.

This is the first record of the larvæ of the genus *Diplostomum* from India. Further observations and experiments are in progress with a view to elucidate the life-cycle of the parasite and histo-pathology of the host's tissue.

Dept. of Zoology,     P. N. GANAPATI.
Andhra University,     K. HANUMANTHA RAO.
Waltair, *July* 19, 1954.

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## DIRECT COTTON DYES

IN a paper on atomic models in relation to some stereochemical problems in dyeing[1] Conmar Robinson has stated that Chlorantine Fast Green BLL has been cited by me as an example of a dye "which is far from linear". The passage under reference[2] reads in fact as follows : "However, an inspection of the scale drawing (Fig. 8) of Chlorantine Fast Green BLL, a dye which is derived from cyanuric acid and has excellent substantivity for cellulose, clearly shows that a substantive dye molecule need not be elongated or threadlike in the sense of the benzidine dyes. More examples are cited later, and it is necessary to emphasize the point that all substantive dyes are not 'long, linear, and planar dye molecules' as stated so frequently."

Robinson has also stated that "the models suggest that, contrary to the usual assumptions, hydrogen bonding to cellulose can take place irrespective of the position of those groups in the dye molecule which are capable of forming such bonds". The following extract[2] will show that the assumption is not usual : "the hydrogen-bonding groups in the dye molecule may be spaced at about 10-11 A to

conform to the repeating units in cellulose; but as seen from the drawings of the five dye molecules in Fig. 7, considerable flexibility in this regard is permissible because of the large number of hydroxyl groups in cellulose".

Dept. of Chem. Tech.,    K. VENKATARAMAN.
Bombay 19, *October* 15, 1954.

1. *Discussions of the Faraday Society*, 1954, No. 16, 123.
2. *The Chemistry of Synthetic Dyes*, Vol. **2**, p. 2, 1283, Academic Press, New York, 1952.

## 'MODERATOR BAND' IN THE HEART OF *COLUMBA LIVIA*

WHILE studying the heart of *Columba livia* for detailed study of its anatomy and histology, a distinct band of muscle fibres present on the left side of septum ventriculorum was noticed. Subsequent study of the structure revealed that such a compact band of cardiac fibres has also been noticed by previous workers who attributed much physiological importance to it. The moderator band has been observed in the heart of *Echidna* and *Platypus* by Davies.[1] He called this band of cardiac muscle fibres as the 'septo marginal bundle' and further stated that the right limb of atrioventricular bundle descends down through it into the papillary muscles at the apical region of the ventricle. Gray[2] in the human heart has also described the continuation of the right limb of the 'A-V bundle' over the moderator band. The structure and disposition of the moderator band was observed



FIG. XXII

Section through the heart of *Columba livia*, × 3.

Abbreviations :—

*a.a*, aortic arch; *a.my.*, auricular myocardium; *At. dm.*, atrium dextrum; *Cor.R.*, coronary sinus; *M.Bd.*, Moderator band; *Rt.av. v.* Right atrio–ventricular valves; *V.dm.*, right ventricle; *V.sm.*, left ventricle; *V. Spt.*, ventricular septum.

in the heart of *Columba livia* in the hand cut sections (longitudinal and transverse), and the results have been confirmed by the study of serial sections of 10 to 15 $\mu$ in thickness.

The moderator band is attached at its anterior end with the cephalic portion of the septum ventriculorum. At this junction the muscle fibres of the septum fuse with those of moderator band. From this point it extends towards the apical portion of the left ventricle almost traversing the left ventricular cavity at its lower end and finally merging with the fibres of the left ventricular wall. Gaskell[3] and His[4] while studying the detailed anatomy of the vertebrate heart stated that the rate of the heart beat could be influenced by ganglia and nerves present at the junctions of atria and ventricles yet the rhythm movements of sinus venosus, atria and ventricles are due to the automatic contractile properties of the cardiac muscle fibres. The supporters of neorogenic theory have laid much stress on the presence of nerves and ganglia at the junctional site in the vertebrate heart. Recently Keith and Flack,[5] Adams,[6] Davies,[1] Prakash[7] are of one opinion that there is a specialised cardiac tissue responsible for initiation, conduction and control of cardiac impulse. The author has also described in detail the conducting system of the heart of birds (*Columba livia, Passer domesticus, Molpastes hœmorrous*) and is in full agreement with the above workers. A careful study of the serial sections reveals the presence of specialized fibres along the course of the moderator band continuous with a strand of Purkinje fibres lying at the base of the inter-atrial septum. For the rhythmic movement of the heart, the right and the left ventricles should beat together at the end of ventricular systole. It would only be possible when the cardiac impulse reaches the right and the left ventricles at the same time. In *Columba livia* the left ventricle is much larger than the right ventricle; in such a condition the wave of excitation obviously would have taken more time to reach the right ventricle. But the presence of specialised conducting fibres over the moderator band provides an additional pathway for the conduction of cardiac impulse from inter-atrial septum to the tip of the left ventricle. In these circumstances the impulse excites both the ventricles simultaneously. In the human heart (Gray[2]) and also in the heart of monotremes[1] the moderator band lies in the right ventricle which is larger of the two. Davies[1] also regarded it as "Peace maker"
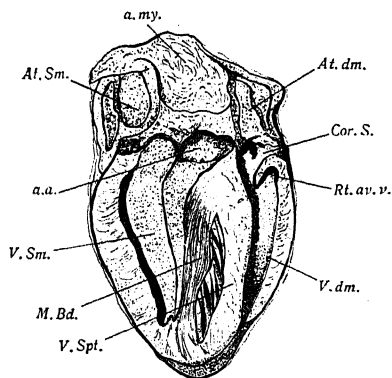
because it prevents overdistension of the ventricle during ventricular systole. It was also suggested by him that the moderator band also spreads the wave of excitation over the entire ventricular area. On the basis of my observations in support of Davies[1] and Gray[2] it is concluded that it is the larger of the two ventricles (either the right or the left) which lodges the moderator band with specialised fibres to act as an additional conducting pathway for the propagation of wave of excitation from the inter-atrial septum to the left ventricle. In addition to it the moderator band in *Columba livia* provides mechanical support to the apex of the heart keeping it anchored to the massive septum ventriculorum.

My thanks are due to Dr. P. N. Mathur for his guidance and to Principal V. V. John for facilities provided.

Dept. of Zoology,                    TEJ SINGH.
Govt. College, Ajmer,
*June 8, 1954.*

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## RECOVERY OF A FISHERY*

WINDOW-PANE oysters, *Placenta placenta*, were being commonly fished ten years ago between Sachana and Pindhara (North Coast of Saurashtra) in the Gulf of Cutch. During the last ten years, however, fishermen could not find live oysters on these grounds, while live oysters were being regularly fished off Poshitra (Bombay State) which is within a few miles of our grounds. Surveys conducted by the Departmental staff did not reveal any live mature stock. Early this year the author again conducted a survey between Pindhara and Panera and came across abundant stocks of mature and immature animals, both live and dead. In all, 850 oysters were collected from various localities and from the length-frequencies it appears that there are at least three fishable *categories* (not necessarily three age-groups): live oysters measuring between 7·1 to 8·0 cm. and 9·7 to 10·3 cm., and dead oysters measuring between 10·0 to 12 cm.

Size at first maturity is not yet known, but from the pearl-dust collected it is safe to conclude that the second category gives a higher yield. A rational exploitation would, therefore, be to fish oysters more than 8·0 cm. long.

A sample consisting of 354 oysters was obtained from the Poshitra fishermen where regular fishery is going on, and was measured in the same way. The range was 7·5 to 11·5 cm., with only one peak at 10·3. That is to say, the majority of them belonged to the second category. The percentage of animals less than 8·0 cm. was 22 per cent. On enquiry it was found that at first the fishermen were fishing in shallow waters where many oysters were small; but now they are fishing in deeper waters and are getting better yields of pearl-dust.

In my opinion, therefore, the only reason for the last ten "barren" years is that our fishermen fished indiscriminately and removed all the potential spawners during the last fishery. This may have been followed by one or two "poor spawning" years, and consequently it took a long time for the fishery to recoup. Detailed investigations on the bionomics, especially the age and rate of growth, spawning season, etc., are in progress.*

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Directorate of Marine Products,
Govt. of Saurashtra,
Jamnagar, *August 23, 1954.*

## ECDYSIAL MECHANISM IN A DECAPOD, *PENAEUS INDICUS*

IT is well known that in arthropods the chitogenous epithelium forms a new cuticle at each moult and preparatory to this process the old cuticle gets separated from the underlying epithelium.[1] Recently Jones[2] described a new ecdysial mechanism in *Trombicula* in which unlike in other arthropods the epithelium in the premoult stages splits into an outer granulated layer which remains in contact with the old cuticle, and an inner cellular layer which gives rise to the new cuticle exposed at the time of moulting. The granulated layer appears to be shed along with the old cuticle. It is of interest to find in *Penœus* a similar histological differentiation associated with moulting. Here the chitogenous epithelium which is formed of a single layer of cells, unlike in the allied forms such as *Homarus*,[3] does

not retract from the overlying cuticle in the stages preceding moulting. In the above stages the epithelium shows a marked increase in number of cells formed by mitotic activity as may be inferred from the occurrence of groups of cells of smaller size in the epithelium. At a later stage it was noticed that a new row of cells is formed internal to the old epithelium from which it appears to originate (Fig. 1). A narrow space separates the two
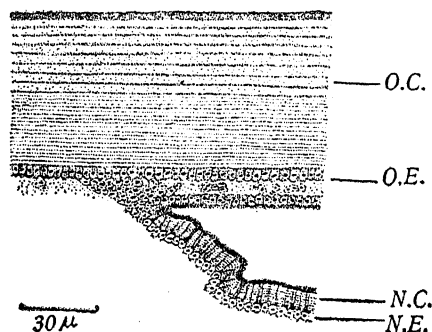


FIG. 1. Section of the late intermoult cuticle showing the new epithelium and cuticle. *N.C.*, New cuticle; *N.E.*, New epithelium; *O.C.*, Old cuticle; *O.E.*, Old epithelium.

cellular layers. It is suggestive that the inner layer of cells is produced by the division of the cells forming the chitogenous epithelium and subsequent migration to form an epithelial layer internal to the old one. This layer gives rise to the new cuticle in which both the epicuticle and endocuticle are distinguishable in the premoult stages.

In the above features *Penœus* differs from other crustaceans and insects so far studied, and recalls in some respects the condition noted in *Trombicula*.[2] The significance of the occurrence of such an ecdysial mechanism in *Penœus* is not obvious although a more extensive investigation of the ecdysial mechanism in arthropods would throw light on the above one.

Thanks are due to Dr. G. Krishnan, and Dr. C. P. Gnanamuthu, for encouragement and criticism during the course of the work.

Zoology Res. Lab.,    A. KRISHNA KUMARAN.
Madras University,
October 1, 1954.

1. Richards, A. G., *The Integument of Arthropods*, 1951, Minnesota University Press.
2. Jones, B. M., *Nature*, 1950, **166**, 908.
3. Yonge, C. M., *Proc. Roy. Soc.*, B, 1932, **111**, 298.

## SOME NEW HOSTS OF *OROBANCHE*

IN continuation of the host list already published by one of the authors[1] this year again six new hosts of *Orobanche indica* as given below were recorded from Dholi (Darbhanga) in the first week of *February* 1954.

| Botanical name | Family | Local name |
|---|---|---|
| *Argemone mexicana* L. | Papaveraceæ | Bharbhar |
| *Blumea glomerata* DC. | Compositæ | Kukroda |
| *Lathyrus sativus* L. | Leguminosæ | Khasari |
| *Oxalis corniculata* L. | Geraniaceæ | Amta |
| *Polygonum plebejum* var. *micranthema* Fran. | Polygonaceæ | Noni |
| *Setaria italica* Beauv. | Gramineæ | Kakun |

Central Sugarcane    D. RAO.
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*July* 27, 1954.

1. Rao, D., *Curr. Sci.*, 1953, **22**, 311.

## HORTOMONE-A AND LATE PLANTING OF SUGARCANE

THE normal period of planting cane in Bihar ends by the middle of March and later plantings are apt to fail in the critical period of germination. The work reported here was undertaken with the object of studying the extent to which soaking of setts in Hortomone-A (I.C.I.) could offset the adverse effects of late planting by stimulating growth of roots (and of shoots as a consequence). Setts of variety B.O. 11 were soaked for 12 hours in a 0·011 per cent. solution of Hortomone-A (25 c.c. in 50 gallons) and planted in rows with four replications on April 2nd. The untreated setts were planted on March 25th. For comparison of germination performance, a periodical examination of roots was carried by uprooting 20 plants taken at random from the rows. The observations were continued as long as it was possible to dig up the plants with the roots intact. Severe infestation of termites and beetle grubs was noted at the last observation in the case of treated setts and as the roots were cut the values of length of roots at the 50-day interval may, therefore, be regarded as underestimations.

The $\chi^2$ values in Table I will show that treatment effects were highly significant. Sett-roots in treated setts were comparatively fewer but sustained much better (being more numerous ultimately) and their mean length was always considerably greater. The number and mean

TABLE I ·

*Effect of Hortomone-A on total numbers and mean lengths of roots*

| Series | Days from planting | Sett-roots | | Comparisons | Shoot-roots | | (Comparisons) |
|---|---|---|---|---|---|---|---|
| | | Total No. | Mean length | | Total No. | Mean length | |
| Treated : | | | | | | | |
| a | 42 | 1125 | 8·48 | 59·7958 (a : d) | 885 | 12·08 | 95·1988 (a : d) |
| b | 46 | 922 | 7·43 | 47·9294 (a : e) | 1009 | 17·85 | 30·8466 (a : e) |
| c | 50 | 1067 | 6·93 | 76·6214 (a : f) | 1179 | 12·45 | 51·5418 (a : f) |
| Control | | | | 87·0628 (a : g) | | | 33·3189 (a : g) |
| d | 42 | 1363 | 6·58 | 47·5467 (a : h) | 650 | 6·71 | 51·3924 (a : h) |
| e | 44 | 971 | 6·18 | 8·5771* (b : f) | 864 | 9·25 | 157·0223 (b : f) |
| f | 46 | 950 | 6·51 | 27·2647 (b : g) | 743 | 9·70 | 164·3285 (b : g) |
| g | 48 | 1124 | 6·08 | 19·7839 (b : h) | 760 | 10·95 | 36·6114 (b : h) |
| h | 50 | 817 | 5·56 | 15·0364 (c : h) | 810 | 13·66 | 26·0019 (c : h) |

\* Indicates non-significant : All others are significant at 1% level.

length of the shoot roots were likewise significantly higher and the same held good for the germination (37·04 per cent. in treated setts as against 20·04 per cent. under control). Thus the utility of Hortomone-A treatment of setts as a measure for offsetting the adverse effects of late-planting is amply clear.

The authors are indebted to Sri. K. L. Khanna, Director, Sugarcane Research and Development, Bihar, for affording necessary facilities for the work and to Sri. M. P. Jha for the statistical analysis.

Entomology Section,      S. B. D. AGARWALA.
Central Sugarcane      S. N. PRASAD.
Res. Station, Pusa,
*April* 6, 1954.

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## CRANIAL MORPHOLOGY OF *CLARIAS BATRACHUS*

THERE is not much literature available on the morphology of the skull of Indian catfishes. The pioneer work in this field has been that of Bhimachar[1] on eight Indian siluroid genera.

The observations of this note deal with the skeletal peculiarities of a primitive, bottom feeding catfish, *Clarias batrachus*. Skulls have been prepared after careful removal of the attached muscles ; and alizarine whole mounts as recommended by Das and Rahim Ullah[2] have also been prepared.

While many siluroid skulls are partially ossified, that of *Clarias batrachus* has been found to be entirely so, there being a very well developed, broad, flattened cranial roofing, which provides a protective covering to the fish. The development of this shield can be easily associated with the sluggish and sedentary habits of the fish, because the skulls of the surface feeders like *Eutropiichthys vacha* and *Pseudeu-*

*tropius* are all together devoid of this structure. It may also be of interest to note that a similar cranial shield in *Opiodon* and other Loricati was described by Gutberlet.[4] Woodward[6] found a similar condition in the skull of *Dactylopterus*. It is quite obvious that such roofing of the skulls of above-mentioned fishes is entirely due to convergence in evolution of bone.

Apart from the presence of a superficial covering which has been shown as a sign of primitiveness by Goodrich[3] in fishes, other primitive characters are also retained by *Clarias batrachus* as given below.

The skull is formed on the platybasic pattern, the vomer is toothed and the orbitosphenoid bone is very well developed. Tate Regan[5] has reported the absence of suprasphenoid (basisphenoid) in all the siluroids. But curiously enough, in *Clarias batrachus* this bone has been found to be completely fused with the parasphenoid along with its lateral margin between the foramina for V and VII nerves. This again is a sign of primitiveness.

It has been stated by Bhimachar[1] that excavations in the hinder region of the siluroid skull, and the development of supraoccipital process can be taken more or less as a measure of progressive growth. It has been found in *Clarias batrachus* that the spina occipitis is not visible externally on the dorsal surface but is completely fused on the ventral side in a form of shelf attached to the posterior occipital region of the cranium. Moreover, feeble development of superior and inferior limbs of posttemporal and the feebler attachment with the 'complex anterior vertebra' further points to the primitive nature of the skull of *Clarias batrachus*.

The author's thanks are due to Prof. D. R. Bhattacharya for his kind encouragement and Dr. S. K. Dutta for his helpful guidance.

Dept. of Zoology,         ANJNI KUMAR.
C.M.P. Degree College,
Allahabad, *August* 11, 1954.

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# MITOSIS IN THE POLLEN MOTHER-CELLS OF *PENNISETUM RAMOSUM* ($2n = 10$)

MITOSIS and other irregularities resulting in the breakdown of microsporogenesis, have been reported recently by Nygren[1] in *Calamagrostis* which is a diplosporous apomict. Both Gustafsson[2] and Stebbins[3] have pointed out that meiotic irregularities, except those peculiar to hybrids, are usually absent in aposporous apomicts. However, in *Pennisetum ramosum* which shows a tendency towards apospory, there is a breakdown of microsporogenesis resembling that described for *Calamagrostis*.

Plants of *P. ramosum*, a native of Central Africa, which had been raised from seeds received from Kew Gardens, England, were being grown in the green-house on the Berkeley campus of the University of California. Only one of these plants showed normal microsporogenesis and good pollen fomation while the rest exhibited various abnormalities of PMC meiosis leading to the formation of completely inviable pollen. It is interesting to note that the irregularities which form such a conspicuous feature of the PMC meiosis were not found on the female side in the EMC meiosis.

This breakdown of meiosis and the consequent degeneration of pollen mother-cells is brought about by the formation of univalents, tetraploid and hexaploid pollen mother-cells (brought about probably by pre-meiotic disturbances), fragmentation of chromosomes, resting PMCs, mitosis, etc. The most commonly observed abnormality, however, is the occurrence of mitosis in PMCs. Entire locules containing PMCs undergoing mitosis were observed. Figure 1 is a photomicrograph of a paraffin section showing an anther locule with PMCs in mitosis. The mitotic chromosomes are seen forming regular equatorial plates and their centromeres are clearly visible. Figure 2 is an



FIG. 1. Anther locule showing mitotic chromosomes in PMCs. Resting nuclei along with mitotic PMCs to be noted.

FIG. 2. Aceto-carmine smear preparation of a hexaploid PMC showing about 30 mitotic chromosomes in anaphase.

aceto-carmine smear preparation showing a hexaploid PMC with about 30 mitotic chromosomes in anaphase. Although many anther locules showed only mitotic PMCs, other locules showing both PMCs in mitosis and PMCs with other irregularities such as the resting nuclei, were also found in some cases (Fig. 1). Features of apospory and the causes of the meiotic breakdown will be reported separately.

My grateful thanks are due to Prof. Stebbins of the University of California for kind guidance.

Dept. of Botany,                 K. N. NARAYAN.
Central College, Bangalore,
*October* 10, 1954.

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## CONTRIBUTIONS TO THE FLORAL MORPHOLOGY OF *TERMINALIA CATAPPA* L.

*Terminalia catappa* belongs to the family Combretaceæ. The present note deals with certain aspects of the floral morphology of this species.

The wall of the anther consists of three to four layers of cells under the epidermis; the innermost of these forms a secretory tapetum (Fig. 1). Pollen tetrads show usually a tetrahedral, but occasionally an isobilateral arrangement. The mature pollen grains are binucleate.

The ovary is inferior, unilocular and contains usually two ovules which are bitegmic, crassinucellate and anatropous. In only one case three ovules have been found in the ovary. An extensive cup-like growth of the chalaza takes place and forms the lower part of the ripe ovule. Only one of the ovules develops into a seed; the rest degenerate and are crushed by the developing seed. Ovary is provided with unicellular hairs which are the modified epidermal cells.

There is a multicellular archesporium in the ovule, but usually only one archesporial cell develops further. Megasporogenesis proceeds normally and the arrangement of the megaspore tetrad is linear or T-shaped (Figs. 2, 3). The development of the megagametophyte corresponds to Polygonum type. The synergids sometimes show a filiform apparatus and their upper parts persist for a long time. The antipodals degenerate early (Figs. 4, 5, 6). In one case two megagametophytes have been observed in a single ovule (Fig. 7). At various stages of megagametophyte development the nuclei of the gametophyte were found to disintegrate (Figs. 8, 9).

Endosperm is nuclear (Fig. 10), and the first division of the primary endosperm nucleus takes place before that of the oospore. Endosperm is completely consumed by the growing embryo. Usually only one embryo develops in an ovule, and the development of the embryo seems to take place according to Solanad type.
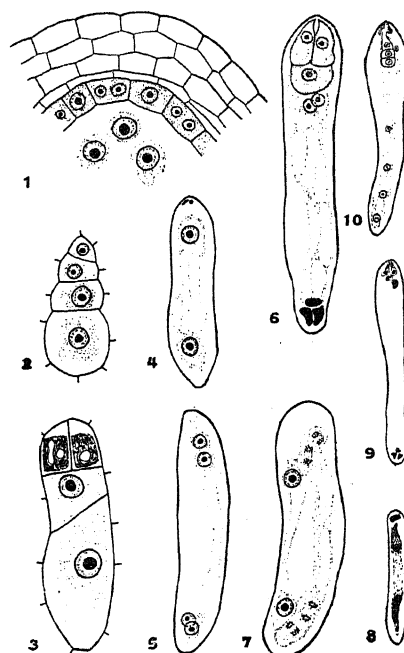


FIG. 1. Anther lobe showing the epidermis, middle layers and tapetum, × 215. FIG. 2. A linear tetrad, × 243. FIG. 3. A T-shaped tetrad, × 243. FIG. 4. Two-nucleate megagametophyte, × 121. FIG. 5. Four-nucleate megagameophyte, × 121. FIG. 6. Eight-nucleate megagametophyte, × 121. FIG. 7. Two megagametophytes in an ovule, × 121.—one ovule four-nucleate with all the nuclei dividing, one two-nucleate. FIG. 8. Two-nucleate megagametophyte with both the nuclei getting degenerated, × 121. FIG. 9. Mature megagametophyte showing all the nuclei degenerated, × 50. FIG. 10. Nuclear endosperm with a three-celled embryo, × 50.

My sincere thanks are due to Prof. L. N. Rao for kind encouragement.

Dept. of Botany,                 M. NAGARAJ.
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*September* 10, 1954.

## UNRECORDED HOST PLANT OF *PENTALONIA NIGRONERVOSA* COQ.

*Pentalonia nigronervosa* Coq. (Aphidæ, Rhynchota), the vector of Bunchy top disease of Banana, is known to have only a limited range of alternate host plants. This aphid has been recorded only from plants belonging to the natural order Musaceæ[1] and Zingiberaceæ.[2,3] In South India the insect is also known to transmit a serious mosaic disease of cardamom.[4]

During the course of a survey of alternate host plants of *Pentalonia nigronervosa* in the high ranges of Travancore, large numbers of both alate and apterous forms were noticed profusely breeding inside the leaf-sheaths of both *Colocasia antiquorum* Schott., and *Alocasia*

*macrorrhiza* Schott. More than 80 per cent. of the plants examined revealed the presence of this aphid and large numbers were noticed during February to May.

The presence of this aphid on plants belonging to Aroideæ recorded here for the first time is interesting because earlier workers were led to believe that this insect could not thrive on hosts other than those belonging to the natural order, Musaceæ and Zingiberaceæ.[1,5]

Further observations on the distribution of this aphid in different parts of the State in relation to the new alternate host are in progress.

University Cardamom        G. Renga Ayyar.
      Res. Station,
Kallar, Travancore,
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## POLYTHENE AND HEAVY METALS

The possibility of heavy metal contamination from plastic containers (American) was studied earlier by Dozer and Dole.[1] In the present study, polythene wash-bottles (Fibernyle Ltd., London) were tested biologically for their heavy metal impurities, using two strains of *Aspergillus niger* van Tiegh.—'M' and 'M.U.B.L.1.'.

After thorough washing with soap and water, the wash-bottles were soaked in strong chromic acid cleaning solution for a week and copiously washed with glass-distilled water. Subsquently they were rinsed in double- and treble-distilled water. (All-glass pyrex stills were used for distillation.) When dry, they were filled with known volumes of slightly acid thrice-distilled water, closed well and set aside for three weeks in a dustless chamber. Later, the water was transferred to clean pyrex beakers and concentrated by evaporation (100 ml. evaporated to 10 ml.). Heavy metal deficient media with the control (+ all) and blank (− all) were prepared as in routine studies made in this laboratory.[2] Two batches were kept, one receiving 0·5 ml. per flask of thrice-distilled water stored in the usual, clean, pyrex containers, and the other, a similar quantity of the water sample from the wash-

bottles. The sterilized flasks were inoculated with a spore suspension of the 'M' strain for detecting iron, zinc, copper and molybdenum, and that of 'M.U.B.L.1.' for manganese assay. Cultures were run in duplicates. After the usual incubation period, the two strains showed the characteristic growth forms and sporulation in the respective series (+ all, − Fe, − Zn, − Cu, − Mn and − Mo)[2] of both the batches, showing thereby no contamination from the wash-bottles. It appears, therefore, that polythene containers (moulded out of I.C.I. Polythene sheets) may conveniently be used in biological studies with the above five heavy metals.

The author thanks Prof. T. S. Sadasivan for getting the wash-bottles from the U.K. and for suggestions.

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Madras-5,
*September* 29, 1954.

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## pF-WATER RELATION IN HEATED SOILS

Heated soils have higher permeabilities for water than normal soils.[5] Heating promotes aggregation of soil particles by the dehydration of clay. Accompanying aggregation there should be variation in pore volume and pore size distribution. It has been shown by actually measuring the capillary and total pore volumes that on heating a soil above 60° C. the capillary pore volume decreases and the non-capillary pore volume increases continuously. By studying the pF-water relation in soils, Baver[1] has shown that the permeability of a soil is dependent not only on the non-capillary pore volume but also on the pF of inflexion point. With a view to correlate the permeability changes in heated soils with the changes in pF-water relation, the normal and heated soils were subjected to tensiometer studies.

The Gangetic alluvial soil of Delhi (India), which was used in the earlier investigation[5] was employed in the present work. The soil was heated for 3½ hours to 60° C., 150° C., 225° C., 360° C., 600° C., 650° C., 800° C. and 1,000° C. The tensiometer technique described by Richards[6] was employed. The soil water was estimated by oven-drying. The non-capillary pore volume was determined from the capillary and total pore volumes in accordance with Zunker's formula. Capillary pore volume is twice the

hygroscopicity which is equal to the amount of water taken up by the soil at relative humidity of 94·3 per cent.[2] This was determined by using a quartz fibre spring balance.[4] The total pore volume was determined from the real and apparent densities.

The pF-water relation reveals the following interesting changes (Table I). The amount of water withdrawn from the soil from zero tension to inflexion point (w. in g.) is the same up to 60° C. and it steadily increases from 60° C. to 1,000° C. The pF of inflexion point first increases upto 60° C., next decreases slightly upto 225° C. Later it decreases more rapidly upto 650° C. From 650° C. to 1,000° C. the decrease is less rapid.

TABLE I

| Temperature of heated soil °C. | wt. in g. per 100 c.c. soil | pF of inflexion point | Porosity factor | Non-capillary pore volume in 100 c.c. soil | Permeability coefficient cm./hour |
|---|---|---|---|---|---|
| N | 20·94 | 2·15 | 9·74 | 45·11 | 5·95 |
| 60 | 20·97 | 2·20 | 9·53 | 43·98 | 5·60 |
| 150 | 21·46 | 2·18 | 9·84 | 45·67 | 6·25 |
| 225 | 21·59 | 2·18 | 9·90 | 45·76 | 6·80 |
| 360 | 21·76 | 2·13 | 10·22 | 48·05 | 10·70 |
| 600 | 22·87 | 1·97 | 11·61 | 49·77 | 16·90 |
| 650 | 23·07 | 1·98 | 11·65 | 50·28 | 18·65 |
| 800 | 24·11 | 1·95 | 12·37 | 52·08 | 17·45 |
| 1000 | 24·30 | 1·83 | 13·27 | 54·20 | 15·60 |

Baver has assumed that the amount of water withdrawn from a soil from zero tension to inflexion point represents the non-capillary pore volume. The permeability is directly proportional to this quantity and inversely proportional to the pF of inflexion point. Extending these generalizations to heated soils the following interesting conclusions emerge. The amount of water withdrawn from soil from zero tension to inflexion point increases on heating the soil, Table I. Similarly the permeability coefficient for water also increases. The relation between permeability and the amount of water withdrawn from zero tension to inflexion point is similar to the relation between permeability and non-capillary pore volume. It follows from this similarity that Baver's assumption is justifiable.

The porosity factor is the ratio of the amount of water withdrawn from zero tension to inflexion point and the pF of inflexion point, and it first decreases with temperature upto 60° C. and next increases up to 225° C. Above 225° C.,

it increases more rapidly. This variation is similar to the variation of permeability coefficient with temperature of heating the soil up to 650° C. This indicates that permeability is dependent upon the combined effects of the pF of inflexion point and the amount of water withdrawn from zero tension to inflexion point. This conclusion is amply borne out by the fact that the permeability-porosity factor relation is linear up to 650° C. Above 650° C., it does not hold good. This apparent anomaly is probably due to the decrepitation in water of strongly heated soil particles analogous to drastically heated silica gel decrepitating in water. The permeability is really that of changed system. As such there is no meaning in extending the above relation to soils heated above 650° C.

Whether the amount of water withdrawn from zero tension to inflexion point is equal to the non-capillary pore volume or is only a measure of it has also been elucidated. The relation indicates that the two quantities are not equal and that the latter is 2·15 times the former.

Though the pF of inflexion point is an important contributory factor in determining permeability, the physical significance is very interesting. In a soil the pores exist in the form of continuous channels. In random distribution these channels have a number of constrictions producing cavities or ink bottle-shaped pores. The cavity concept was first suggested by McBain[3] and later elaborated by Rao, K. S.[4] These constrictions are responsible for producing the sorption-desorption hysteresis which is a static phenomenon connected with the equilibrium between liquid and vapour phases.

Permeability is essentially a phenomenon of liquid flow in pores and is governed by Poiseuille's Law. As water flows through the constricted channels the constriction or necks offer the maximum resistance to flow and the rate of flow is really governed by the diameter of these necks. Assuming that the pF of inflexion point signifies the neck diameter, the variation in permeability with variation in pF of inflexion point is easily intelligible. The pF of inflexion point in the pF-water curves denotes the most predominant pore size. According to the cavity concept, if the pF of inflexion point stands for neck diameter, the amount of water that can be withdrawn from the soil without changing the pF at the inflexion point appreciably, represents the amount of water entrapped by the cavities. A detailed account of these interesting results is being published elsewhere.

The authors are grateful to Dr. D. S. Kothari, for his keen interest in the work.

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Defence Science Organisation,
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New Delhi, *September 8, 1954.*

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## INTERNODAL LENGTH AS AN INDEX OF MEASUREMENT FOR DROUGHT RESISTANCE IN GROUNDNUT

IN Hyderabad State groundnut is grown as a rainfed crop in the kharif season, and bunch varieties are a rule rather than an exception in sandy soils (locally known as 'Chalkas') of the Telingana Districts which are very poor in their moisture-holding capacity (20 per cent. approximately). Sowing commences from the third week of June with the onset of the monsoon and extends to the second week of July and the crop comes to harvest by the end of October. Usually there is a period of twenty-five to thirty non-rainy days in September and October at the cessation of the south-west monsoon, coupled with high temperatures, and this period coincides with the development of the pods underground. It is during this period that the plant requires optimal conditions for the successful development of the pod and any deviation from the normal, adversely affects the filling of the pods, resulting in low yields.

Different indices[1,2,3,5–8] have been used to measure the resistance to drought in different crops. In a varietal test of $7 \times 6$ randomised blocks sown in a chalka plot comprising of the following seven bunch varieties, *viz.*, Kopargaon-1, Spanish Improved, Spanish-9, Spanish-5, Tindivanam-2, Kopargaon-3 and Local bunch, the number of plants wilted, out of a total population of 2688 per variety, during the period of soil and atmospheric drought, were noted and the data shown in Table I. It was found that Kopargaon-1 was the most resistant with the least number of wilted plants while Kopargaon-3 was the most susceptible to drought. In addition, some of their physiological attributes such as leaflet length and width, leaflet area, internodal length and the total number of shoots per plant were recorded. Five plants from each replication were selected at random and for the measurement of internodal length four shoots consisting of the main axis and three randomly selected primaries from each plant have been taken and on each of these four shoots, four internodes at random were measured, *i.e.*, sixteen internodal measurements. The capacity of the plants to withstand wilting was found to be associated with plants having shorter internodal length. When correlation coefficients were calculated[4] between the number of wilted plants and other physiological attributes, it was found that there exists a highly significant positive correlation ('$r$' : 0·7665) between the internodal length and the number of wilted plants. Internodal length can reasonably be assumed as an index for comparing the capacity of the plants to withstand drought. This relationship was found to hold good only when comparisons are made amongst bunch varieties but not between bunch and spreading varieties.

Acknowledgement is due to Dr. L. G. Kulkarni, the then Oil Seeds Specialist, for initiating the problem and for guidance at the early stages.

TABLE

*Analysis of variance for the number of wilted plants*

| Due to | | D.F. | S.S. | M.S.S. |
|---|---|---|---|---|
| Totals | .. | 41 | 325192·0 | 7931·5 |
| Varieties | .. | 6 | 321899·6 | 53649·9 |
| Blocks | .. | 5 | 978·8 | 195·7 |
| Errors | .. | 30 | 2313·6 | 771·2 |
| | | | S.E. | : 16·032 |
| | | | C.D. | : 32·7 |

| Kop-3 | Sp-5 | T.M.V.-2 | Sp-9 | Local Sp. | Imp. | Kop-1 |
|---|---|---|---|---|---|---|
| 310·5 | 258 | 185·5 | 108 | 103·6 | 89·6 | 59·6 |

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Himayatsagar, Hyderabad (Dn.).
*August 16, 1954.*

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# REVIEWS

**The Collected Papers of Peter J. W. Debye.** (Interscience Publishers, Inc.), 1954. Pp. xxi + 700. Price $ 9.50.

This selection of classical papers by Professor Debye was presented to him by his pupils and well-wishers on his seventieth birthday. The selection was made by Professor Debye himself. The papers originally published in German and Dutch have been translated into English, while those in English have been reproduced directly from the original journals. A more appropriate title would have been "Selected Papers", for it would avoid persons like the reviewer being disappointed when they do not find a particular paper of Debye which they would like to refer to.

Broadly, the papers may be divided into four types, dealing respectively with X-ray scattering, dipole moment and polarisability, electrolytes, and scattering of light. In each of these fields, Debye has been the originator of brilliant ideas which have opened up new vistas in science. A brief survey wherein the contributions of Debye are viewed in the light of later developments that came out of them serves as an admirable introduction to the collected papers.

One cannot but admire the versatility of this genius, who has contributed something to almost every branch of physics and physical chemistry. Science to the majority is perhaps only a cold business of logic and symbols and experiment; but there are also a few to whom it can be a creative art as well. Of this choice company, Debye is a name to reckon with, as is that of Raman in our own country.

G. N. RAMACHANDRAN.

**The Physics of Experimental Method.** By H. J. J. Braddick. (Chapman & Hall), 1954. Pp. xx + 404. Price 35 sh.

As Professor Blackett says in his preface, far fewer text-books suitable for the advanced student have been written on the methods of experimental physics than on special branches of physical knowledge. Perhaps the only other book available is Strong's *Modern Laboratory Practice*. Braddick's approach to the subject is however from a slightly different angle—the emphasis being on the basic principles rather than on detailed techniques. Strong is an indispensable companion to be had by the side in the laboratory, but Braddick must be read and mastered before a student takes up real experimental work.

The first chapters of the book discuss the errors involved in physical measurements and the methods of estimating them and the reduction of required quantities from the experimental data. Even during the brief period that the reviewer had the book with him, the students in his laboratory have made use of this section a number of times in connection with their researches. It is unfortunate that this aspect of experimental physics is rarely touched upon in the teaching of physics in our country. The next few chapters are concerned with the design of apparatus and a discussion of the properties of materials which go into their construction. Vacuum technique is discussed in a brief chapter of forty pages. The succeeding chapters deal with electrical and electronic techniques, and with optics and photography. The book ends with an account of special techniques in nuclear physics.

Every chapter is studded with choice and valuable information. In particular, the portion dealing with electronics should be read by every student taking to research in experimental physics. Dr. Braddick has indeed done an immense service to the younger workers in making available to them a compendium of knowledge which otherwise they had to obtain bit by bit in the hard school of experience.

G. N. RAMACHANDRAN.

**Relays for Electronic and Industrial Control.** By R. C. Walker. (Chapman & Hall), 1953. Pp. xi + 303. Price 42 sh.

The part played by relays in electrical engineering practice is a considerable one, whether the purpose is safety, sequential operation or automatic control. The paucity of books on this important subject has been felt for sometime and the late R. C. Walker has done a distinct service by bringing together in cogent form the extensive literature on the subject in the book under review.

The relay is essentially a low power device for controlling large power or performing pre-

arranged operations. In the main, it may be electromagnetic, thermal or electronic. It can have other features like polarity, speed and delay.

The electromagnetic type consists of coil and iron circuits and contacts, and their design is treated in Chapters 2-4. Special considerations with this type of relay are the varying inductance due to the movement of the core and the difference between the closing and holding currents, which governs the stability of the relay. The contacts offer interesting electrical and mechanical problems like contact resistance, optimum pressure, arcing, bounce and chatter. The author has discussed these design features starting right from the first principles.

Chapters 5 and 6 deal with the different types of relays used in D.C. and A.C. operation. The telephone relay, mercury switch, micro-relay and galvanometer relay are the typical D.C. examples; the last two are particularly suited in sensitive operations with currents in the range of microamperes. The induction, balanced beam, astatic voltage relays are some of the important A.C. types considered. In A.C., additional problems like response to frequency and ripple come up and these, together with the elements of protective systems in power circuits, are discussed.

In connection with the speed of relays, the Siemen's and Carptener types, useful in millisecond ranges, are discussed. Chapter 8 is devoted to a discussion of time elements in relay operation or release. Where the time element is fairly large, this can be achieved by mechanical devices. Some thermal and electronic artifices are also considered. The thermistor is another useful component in providing delayed switching.

The last two chapters deal with the operation and control of relays like latching, interlocking and mastercontrol and their miscellaneous applications like response to $n$th impulse, control of acceleration and torque and battery charging devices.

The main appeal of this book will be of course to the engineer and instrument specialist. For this reason, perhaps some of the discussions could have been more analytical like, for instance, the micro-relay movement or the high speed relays. But this is partly compensated by the references to be found at the end of each chapter.

On the whole, the author and the publishers are to be congratulated for bringing out a very readable account of a subject of great utility and interest.

K. S. CHANDRASEKARAN.

**Annual Review of Biochemistry, Vol. 23,** (Published by Annual Review Inc., Stanford, California), 1954. Pp. ix + 636. Price $ 7.00.

The present volume of the *Annual Review of Biochemistry* is as comprehensive as its predecessors in the treatment of the various topics in biochemistry. The prefatory chapter, which has been an innovation since last year, has been written by the veteran Dr. Karl Thomas, who in a very lucid autobiography has also reviewed fifty years of biochemistry in Germany. The succeeding chapters on biological oxidations, proteolytic enzymes, chemistry of the carbohydrates, nucleic acids, carbohydrate metabolism, chemistry of proteins, peptides and amino acids, fat-soluble vitamins, water-soluble vitamins, nutrition, the biochemistry of muscle and of hormones, the clinical applications of biochemistry, mineral metabolism, thyroid hormones and iodine metabolism, metabolite antagonists, and non-oxidative and non-proteolytic enzymes, have been written by authors, who have been active investigators in these special fields of study. It is noticed, however, that some of the authors have not gone through the literature for the whole year before writing their respective review articles. A few have done up to September, while others have gone up to October or November. Jean Roche and Michel in their article on thyroid hormones and iodine metabolism state that they have included the literature only until July of last year. Since the authors of the various chapters of the annual review are different from year to year, it appears desirable to have a common date for the coverage of literature, though not necessarily the last month of the year under review.

The special articles such as metabolite antagonists, clinical applications of biochemistry and the recent advances in the biochemistry of muscle and of cancer are very welcome features of this volume. Mention may also be made of some of the highlights such as the excellent discussion of fatty acid oxidation, nerve patterns of carbohydrate dissimilation, the exhaustive treatment in two chapters of the water-soluble vitamins and the biosynthesis and metabolism of phosphorus compounds. The extensive use of tracer technique employing radioactive carbon, sulphur, phosphorus and iodine labelled compounds is also clearly seen in many articles of this annual review. The volume as a whole maintains a high standard for critical appraisal of world biochemical literature, and should prove indispensable to every biochemist whether he is engaged in teaching or research. P. S. SARMA.

**Methods and Principles of Systematic Zoology.** By E. Mayr, E. G. Lenslay and R. L. Usinger. (McGraw-Hill), 1953. Pp. 328. Price $ 6.00.

The book consists of 17 chapters arranged in three parts. Every page is packed with information which the authors have gleaned during their long periods of teaching. The information is of a kind the student rarely gets from text-books or other books of reference.

The authors have clearly dealt with the value of the study of classification, the definition of species, the infraspecific and supra-specific categories and the different sets of morphological differences that have to be studied in different populations. Chapters 7-14 will be invaluable to students and staff who have a research bent. Analyses of quantitative data, presentation of findings and preparation of taxonomic papers are topics which make this book indispensable to them. Chapters 10-17 dealing with zoological nomenclature will be indispensable to authors in the matter of naming up new species.

In short, the authors as well as the publishers must be thanked for not only the contents of the book, its treatment, its bibliography, its glossary of technical terms and its index, but also for its most attractive get-up. Any college or research library will be the poorer without this book.

C. P. GNANAMUTHU.

**International Review of Cytology, Vol. II.** (Academic Press, Inc.), 1953. Pp. vii + 545. Price $ 11.00.

The second volume of the *International Review of Cytology* reflects the increasing interest evinced by biochemists and biophysicists alike in problems centering around the gene and its mode of action. For some time now, the attack on problems in cell physiology has been on a broad front employing the techniques and methodology of different disciplines. This has resulted in advances in several directions. It is not surprising, therefore, that as in the preceding one, the reviews in this volume also are on a variety of topics like the cell nucleus, electron microscopy, cytochemistry, transport phenomena and growth and differentiation.

Perhaps the most stimulating contribution is that of Glick which critically appraises the current approaches in quantitative histo- and cytochemistry. His conclusions deserve attention. Regarding the judicious use of diverse methods, he observes: "The usefulness of the imperfect method lies in an understanding of the boundaries of its effective application, and

the good judgment to confine its use to those areas in which the methodological uncertainties will not confuse the interpretations" (p. 470). Glick believes that progress would be possible only if better and finer tools are fashioned and the existing tools and techniques refined.

Some investigators (Swift, p. 67), have expressed the hope that quantitative studies would remove subjectivity, which has been considered one of the drawbacks of formal cytology. The recent investigations reviewed in the volume do not however, justify such a hope. Interpretations as distinct from observations still remain subjective.

Classical cytology has been static for the past many years. The recent advances in cell physiology reveal the necessity for some bold generalizations. The volume under review is a mine of information and should find a place in any good scientific library.

M. K. SUBRAMANIAM.

**Discovery Reports, Vol. 27.** (Issued by the National Institute of Oceanography.) (Cambridge University Press), 1954. Pp. 218. Price 78 *sh.*

The present volume of *Discovery Reports* consists of three parts:

*Part I.*—The Siphonophora of the Indian Ocean are reported on by A. K. Totton of the British Museum. Only those who have ever reported on the taxonomy of planktonic forms can adequately appreciate the patience and methodical listing and description of these easily fragmented forms occurring in different stages of development. To us in India, where zoology is confined mainly to colleges and university departments, Totton's discussion of the relationships of the Siphonophora to the rest of the Cœlenterata would be of interest—especially as Hyman, whose book is used in most institutions, considers the primordial ancestor of all cœlentera as medusoid in form. He divides the "Siphonophores" into two entirely distinct orders, the Chondrophora including *Velella, Porpita* and *Porpema,* and the Siphonophora, and regards the former as highly modified Tubularid hydroids and the latter as meduoids with polypoid larval stages. This would lead one to picture the original ancestor of both the orders and therefore of the cœlenterata as a whole, as of a polypoid form. The problem is really a "vexing" one, since the medusoid plan of body can be derived from that of polypoid and *vice versa,* since both can give rise to buds and since the simplest larvæ of hydroid forms are pelagic.

The entire account is well illustrated by excellent figures and plates.

*Part II.*—The pelagic mollusca of the Benguela current and the reproductive system of *Limacina bulemoides* are reported on by M. E. Morton. Of the eleven species of pelagic mollusca described, only two closely allied species have been recorded from Madras. The account of the depth distribution of these molluses will be of interest to students of the plankton of the Indian coast.

*Part III.*—The circumpolar continuity of Antarctic plankton species by A. de C. Baker is of interest in establishing an idea expressed by several others, as a fact of observation.

This volume as a whole, like the others, does credit to both the authors and the publishers, and must be included in every zoology library.

C. P. GNANAMUTHU.

**Genetic Homeostasis.** By L. Michael Lerner. (Oliver & Boyd, Edinburgh), 1954. Pp. vii + 134. Price 12 *sh.* 6 *d.*

To those who are not familiar with the term 'homeostasis', the title of the book appears somewhat forbidding. However, the author in his introductory chapters soon clears this difficulty, by defining homeostasis as the property of an organism to adjust itself to variable conditions. It is the self-regulatory mechanism of an organism which permits to stabilize itself in fluctuating inner or outer environments. The word homeostatis was coined by W. B. Cannon as early as 1932 in the field of physiology, as 'the totality of steady states maintained in an organism through the co-ordination of its complex physiological process'. Once the hurdle of the title is surmounted it is easy to understand genetic homeostasis as the elaboration of the idea of 'genetic inertia' postulated by Darlington and Mather in 1947. It is the 'property of the population to equilibrate its genetic composition and to resist sudden change'. The author demonstrates that Mendelian populations possess self-regulating properties to establish a connection between genetic and developmental homeostasis and to suggest that heterozygosity provides a basis for both phenomena. He next considers the consequences of these points for evolution and breeding.

The ideas propounded are by no means original. Mather and his collaborators brought out the relationship between individuals and population as early as 1943. The framework of the book is old. The label is new. The originality lies in that the chief emphasis is placed on data from artificial selection from domestic animals, including previously unpublished data from the author's own laboratory.

The book brings together post-war data on population genetics and shows that the 'best adapted form in a species is usually one that is close to the average in all quantitatively varying characters. The superiority of heterozygous over homozygous genotypes and the role of selection in maintaining heterozygous forms by means of rejection of deviant homozygous types has great importance in breeding. The book is well illustrated and has many informative graphs and diagrams.

E. K. JANAKI AMMAL.

**Proceedings of the Fifth Conference on Cotton Growing Problems in India,** March 1952. (Published by the Indian Central Cotton Committee, Bombay), 1953. Pp. xii—118. Price Rs. 4.

A perusal of the proceedings of the recent conference on cotton-growing problems in India, published recently, shows that this conference has fulfilled the chief objects for which such conferences are generally held: firstly, to provide a common platform for research workers engaged in various branches of science connected with cotton-growing to discuss problems of mutual interest to them, and secondly, to afford an opportunity for junior workers to meet the seniors in a scientific atmosphere and discuss problems with an open mind unbiassed by administrative considerations.

Thirty-four papers—9 on cotton breeding and genetics, 11 on cotton agriculture, 3 on statistics, 8 on cotton technology and 3 on cotton pests and diseases—were read and discussed. Summaries of these papers and discussions on each would certainly be of value to other workers in their respective fields who had not participated in the Conference. As was observed by the President in his address, the programme dealt with various subjects related to cotton, for instance, plant breeding and genetics, agronomy of cotton, diseases and pests, cotton statistics and last, but not the least, technological research on cotton. No one can expect that one can be an expert in all these branches. In view of this, it is suggested that full papers may be published instead of summaries, as otherwise, a non-participant in the conference may not be able to follow the discussions with advantage.

C. NANJUNDAYYA.

Books Received

*Nuclear Species.* By H. E. Huntley. (Macmillan & Co.), 1954. Pp. xix + 193. Price 21 *sh.*

*Chemical Pathways of Metabolism,* Vol. II. Edited by David M. Greenberg. (Academic Press Inc.), 1954. Pp. viii + 383. Price $ 9.50.

*Entire Functions—Pure and Applied Mathematics Series of Monographs and Text-Books,* Vol. V. By R. P. Boas Jr. (Academic Press, Inc., N.Y.), 1954. Pp. vii + 276. Price $ 6.00.

*Distribution of Radio Brightness on the Solar Disk.* (Special Report No. 4.) *Interstellar Hydrogen.* (Special Report No. 5.) (Published by Union Radio-Scientific Internationale, Brussels, LE.), 1954. Pp. 72. Price 14 *sh.* 6 *d.*

*Physiology of Insect Metamorphosis*—Cambridge Monographs in Experimental Biology. By V. B. Wigglesworth. (Cambridge University Press), 1954. Pp. vii + 151. Price 12 *sh.* 6 *d.*

*Acoustics.* By Leo L. Beranek. (McGraw-Hill), 1954. Pp. x + 481. Price $ 9.00.

*Chemistry of Heterocyclic Compounds—Heterocyclic Compounds with Indole and Carbozole Systems,* Vol. VIII. By W. C. Sumpter and F. M. Miller. (Interscience Publishers, Inc.), 1954. (Agents in India : Asia Publishing House, Bombay.) Pp. xii + 307. Price $ 10.00.

*Electronic Measuring Instruments.* By E. H. W. Banner. (Chapman & Hall), 1954. Pp. xiv + 395. Price 45 *sh.*

*Physical Chemistry.* By A. J. Rutgers. (Interscience Publishers, Inc.), 1954. Pp. xix + 804. Price $ 8.50.

*Technique of Organic Chemistry—Micro- and Semi-Micro Methods,* Vol. VI. By Nicholas D. Cheronis. (Interscience Publishers, Inc.), 1954. Pp. xxiii + 628. Price $ 12.00.

*Colloid Chemistry.* By B. Jirgensons and M. E. Straumanis. (Pergoman Press), 1954. Pp. xvi + 420. Price 40 *sh.*

*High Polymers—Cellulose and Cellulose Derivatives,* Vol. V, Part I. Edited by Emil Ott, Harold M. Spurlin and Mildred W. Grafflin. (Interscience Publishers, Inc.), 1954. Pp. xvi + 509. Price $ 12.00.

*New Instrumental Methods in Electrochemistry.* By Paul Delahay. (Interscience Publishers, Inc.), 1954. (Agents in India : Asia Publishing House, Bombay.) Pp. xvii + 437. Price $ 11.50.

*Recent Progress in Hormone Research—The Proceedings of the Lawrentian Hormone Conference,* Vol. X. (Academic Press, Inc.), 1954. Pp. 511. Price $ 9.80.

*The Fruit, the Seed and the Soil—Collected Edition of the John Innes Leaflets,* Nos. 1-9. Edited by W. J. C. Lawrence. (Oliver & Boyd), 1954. Pp. viii + 92. Price 5 *sh.*

# SCIENCE NOTES AND NEWS

### Non-Poisionous Preservative for Sugarcane Juice

S. V. Ramanayya and M. S. Ramachandramurthy, Etikoppaka Sugar Factory, Etikoppaka, report that thymol ($C_{10}H_{14}O$) has been found to be very efficacious as antiseptic and specific for the preservation of sugarcane juice during sampling and analysis in factories. By using thymol, instead of the basic and neutral acetates of Pb and iodides and chlorides of Hg, the materials now in use, large quantities of the juice need not be thrown away as at present.

### Bicapillary Apocarpous Gynoecium in *Crotalaria laburnifolia* L.

Sri. K. V. Sambaśiva Rao, Department of Botany, Sri Venkateswara College, Tirupati, reports that he came across a case of bicarpellary apocarpous gynoecium in *Crotalaria*

*laburnifolia* L. The usual single carpel is borne on a sufficiently long cylindrical stalk, the gynophore. The gynophore in the abnormal flower is flattened, showing a double nature with a prominent median groove running right from the very base to apex, where it is branched bearing two free carpels each ending in its own style and stigma. One of the carpels is of normal size bearing sixteen ovules, while the other is about half the size bearing only eight ovules. This may probably be due to lack of adequate nutrition or due to its having developed from the left over residual meristem.

### Collateral Vascular Bundles in Orchids

B. N. Mulay, T. K. B. Panikkar and M. K. Prasad, Birla College, Pilani, state that they have observed collateral vascular bundles in the terrestrial roots of certain Orchids like

*Microstylis rheddi* Nutt. and *Liparis atropur-purea,* Lindl. Details of this work will be published elsewhere.

## Systematic Studies in Botany and Zoology

A conference to discuss the importance and need of systematists was organised by Dr. Waldo L. Schmitt, Head Curator, Department of Zoology, U. S. National Museum, at Washington in August 1952 on behalf of the Society of Systematic Zoology. It is intended to get the report of this Conference published in book form for the benefit of non-systematists. To make it more useful it is desired to cite instances of incidents of the practical application of systematics and taxonomic studies, particularly with a view to draw the attention and get proper recognition of Foundations and fund granting agencies towards this much neglected, though fundamentally important subject.

All workers in the systematics of botany and zoology are requested to send their suggestions, notes, references, etc., on the utilitarian aspect of systematics to Dr. S. L. Hora, Director, Zoological Survey of India, Calcutta, at their earliest. It is intended to collate information thus received upto January 5, 1955, and to forward it to the organisers of the Conference.

## Refractories in Metal Industry

A symposium on 'Recent Trends in the Fields of Production Practice and Research and Testing of Refractories used in Metal Industry' will be held on 19-21 January 1955 at the National Metallurgical Laboratory, Jamshedpur. The following foreign scientists are presenting papers to the symposium: Dr. J. B. Austin, U.S.A.; Dr. J. W. White, England; Miss Louise Halm, France; Prof. Yamauchi, Japan; and Prof. Dr. H. Salmang, Netherlands. In addition to reading and discussion of technical papers, the following special lectures have been arranged: "Graphite" by Dr. K. S. Krishnan, Director, National Physical Laboratory of India, New Delhi, and "A Metallurgist looks at Refractories Research" by Mr. E. H. Bucknall, Director, National Metallurgical Laboratory.

## Electric Power from Sea Water

The production of electric power by mixing fresh and salt water in the hydro-electric pile is discussed by R. E. Pattle in the October 2 issue of *Nature* (p. 660).

The osmotic pressure of sea-water is about 20 atmospheres so that when a river mixes with the sea, free energy equal to that obtainable from a waterfall 680' high is lost. There thus exists an untapped source of power which has not been noticed before. The British experiment put the osmotic pressure to work by separating alternate layers of salt and fresh-water by alternate basic and acidic membranes that incorporate ion-exchange resins. When such membranes separate salt solutions of different strengths, a potential difference appears. The membranes are connected in series. A hydroelectric pile of 47 pairs of membranes each 8 cm. square yielded a maximum of 15 mw. output power at 39° C. At low temperatures the internal resistance is higher and the power output is lower. The pile is therefore likely to be more successful in a warm climate. Whether the process will be economical probably depends upon the time it will run before the membranes need replacing and the interior needs cleaning.

## X-Ray Microscope

The General Electric Co., U.S.A., has developed an X-ray microscope which is capable of wide use in medical science, biology and industry.

In the G.E. X-ray microscope, the X-ray source is only a fraction of a micron in diameter. This is achieved by focussing the electrons through two electrostatitc lenses, which are essentially doughnut-shaped metal rings to which voltage is applied. The magnified X-ray image thus obtained can be seen by the eye or photographed for permanent record. The instrument provides great stability for the longer exposures needed for high quality pictures, and is the first to employ a built-in camera that provides developed photographs immediately after a subject is exposed.

In the study of heredity with the tiny fruit-fly, only exterior changes in the insect can be easily observed, with ordinary microscopes, but with the X-ray microscope changes in the internal organs can be observed equally well and in three dimensions. In the study of alloys, plastics and composition rubber, the X-ray microscope shows the mixture of the materials and can identify them by their relative X-ray absorbing power.

Sterling P. Newberry, electron-optics engineer of the G-E General Engineering Laboratory at Schenectady, N.Y., was co-authored by Selby E. Summers, in the development of the instrument.

## Scientific Liaison

It is now six years since the UNESCO set up the network of science co-operation offices at representative centres on the globe. With these offices, UNESCO has sought a new solution to the old problem of international scientific co-operation. Set up on an experimental basis, they are now a permanent element in the world's facilities for exchange of scientific information.

The story of this network and the results it has obtained is told in a new illustrated booklet, *Science Liaison*, published by UNESCO. The main task of UNESCO science co-operation offices at Montevideo, Cairo, Istanbul, Delhi and Jakarta, is to assist scientists in obtaining information and materials within a reasonable length of time and without wasted effort. In particular, the offices endeavour to provide scientists in under-developed regions with facilities to overcome the obstacles of which they have an inordinately large share.

## Bulletin of CGCRI, Calcutta

The inaugural number of the *Bulletin of the Central Glass and Ceramic Research Institute*, Calcutta, has been published. The Bulletin is to be issued as a quarterly devoted to the cause of the advancement of glass, ceramics and allied sciences and industries. The Bulletin will contain discussions of important current topics relating to glass and ceramic industries, technical articles dealing with the scientific aspects of the manufacturing operations involved in industry, contributed articles from the representatives of producers and consumers of glass, enamels, pottery, etc., articles on production and quality control, short notes on important new developments in techniques of production, equipment, etc., statistical information, abstracts from technical journals dealing with these industries, news and reviews of books.

Articles of interest in the present number are: glass containers suitable for distilled water by Atma Ram, S. P. Krishnaswamy, (Late) P. Roy and S. Sen; 'Studies on Saggars' by Atma Ram, J. C. Banerjee and N. B. Chatterjee. The annual subscription of the Bulletin is Rs. 6. For copies apply to: Central Glass and Ceramic Research Institute, Jadavpur, Calcutta-32.

## Bulletin of the C.L.R.I., Madras

The Technical Bulletin of the Central Leather Research Institute has hitherto been issued in cyclostyled form for private circulation and contained mostly abstracts of research publications on leather science. Since August, it is being issued in an enlarged and printed form, and will contain in addition to abstracts, research papers of the Institute and other articles on leather technology. Trade advertisements of interest to leather research workers and leather industry will also be a feature of the enlarged bulletin.

The inaugural number contains two articles, on "Some Aspects of Leather Manufacture" by B. M. Das, and "Acid Salt Ratio of Indian Tanstuffs" by J. C. Sen, besides classified abstracts and Science Notes and News. The Bulletin is a monthly, and copies of it may be ordered from the Director, C.L.R.I., Madras-20.

## M. R. Nayar Memorial Fund

Funds are being raised for creating an endowment in the name of the late Dr. M. R. Nayar, Department of Chemistry, of the Lucknow University. An appeal for generous contribution is being made by the Nayar Memorial Fund Committee. Subscriptions to this fund may kindly be sent to: Sri. S. C. Varma, Honorary Treasurer, Nayar Memorial Fund Committee, Chemistry Department, Lucknow University, Lucknow.

## Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Physics to Sri. K. Suryanarayana Rao for his thesis entitled "Certain Theoretical Studies in Complex Spectra and Rotational Analysis of Columbium Oxide Bands".

The Andhra University has awarded the D.Sc. Degree in Technology to Sri. A. Venkateswarlu, for his thesis entitled "Heat Transfer with and without Phase Change in Square and Rectangular Conduits".

The University of Poona has awarded the Ph.D. Degree in Geology to Shri B. G. Deshpande for his thesis entitled "Ground-water Resources of the Alluvial Tracts of Gujerath, Bombay State".